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Apply Modern Construction Methods on Wilmington Dam

Pump 150,000 Barrels of Cement to Construction Site from Special Bulk Cement Railway Cars—Concrete Distributed by Continuous Belt Conveyors

By RALPH P. BROWN
Lakewood, Ohio

THE water supply plans of the City of Wilmington, Delaware, involve a storage reservoir in a valley about 7 miles northwest of the city, the water impounded being piped to the city through concrete pipe. The lower dam, which is 110 ft. high from the base to the spillway, required approximately 102,000 cu. yd. of concrete. It was built during the latter part of 1930.

Novel construction methods featured the placing of concrete in this dam, two outstanding items being the use of belts for conveying the concrete from the mixer to the dam, and the use of a Fuller-Kinyon pneumatic pumping system for bringing the cement in bulk from cars on the railway siding to the mixer. Both features saved time and labor and facilitated the work to a high degree.

Bulk Cement in Special Cars

Bulk cement was used on this contract, and was supplied by the Hercules Cement Corp., in their special bulk cement cars. These cars were dropped from the train on an 8-car switch track and spotted at a central point, where they were unloaded. The unloading plant was designed to handle two cars at a time, and the usual cement shipment was four cars at a time. The cars have four hopper doors on each side, and these were spotted over spouts which connected to the outlets by means of heavy canvas tubes, thus eliminating the dust nuisance.

As the cement feeds from the cars by gravity it is picked up by a screw conveyor and taken direct to a 900-barrel metal storage bin (Figure 1). This bin in turn feeds the pumping system, which in this installation blew the cement 3,000 ft. to the mixer. This pneumatic pumping system, said to be the longest yet used outside of a building, saved a 6-mile haul which would otherwise have been required to bring the cement from the nearest siding where trucks could be loaded, and it proved very economical in operation. The pipe crossed a 30-ft. stream, where it was suspended on a wire rope, then passed under a highway which had to carry all sand, gravel and construction material, and then up a pulley to the mixing plant.

As the mixing plant used from three to four carloads of cement per day, it will be readily seen how great the saving was in truck time, labor in loading and unloading trucks, and danger of delays, to say nothing of the increased congestion which would have been caused on the narrow construction road leading from the highway to the mixing plant.

The Concrete Mixing Plant

Washed sand and gravel meeting city specifications was supplied to the job by the Warner Company of Wilmington. These aggregates were delivered to storage piles in 5-ton dump trucks. Twin material bins of Butler manufacture holding 75 cu. yd. each of sand and gravel over the mixer were kept filled at all times by a clamshell

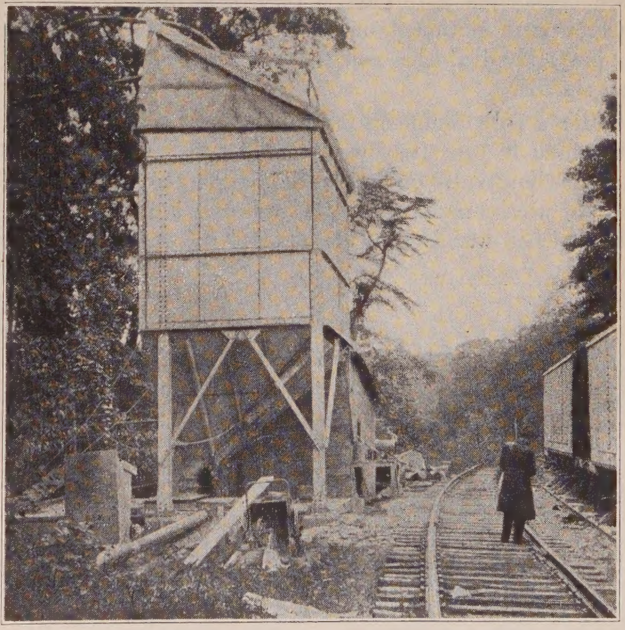

Figure 1. Cement bin and pump house installed at railway siding for pumping cement to construction site

bucket (Figure 2). From the bins the material was fed direct into a Batcher Bin Co. unit having five compartments, two each for sand and gravel, and one for cement. The cement bin was kept filled by the pneumatic pumping system.

All material going into the mixer was weighed, Winslow scales having been used for this purpose. Water was measured through a tank. A 3-cu. yd. Smith tilting mixer was found equal to the task of supplying all concrete used on the job, an output of 1,000 cu. yd. per day having been considered a full day's run. One man and an inspector were stationed on the mixing platform, and an engineer handled the machinery below in accord with bell signals.

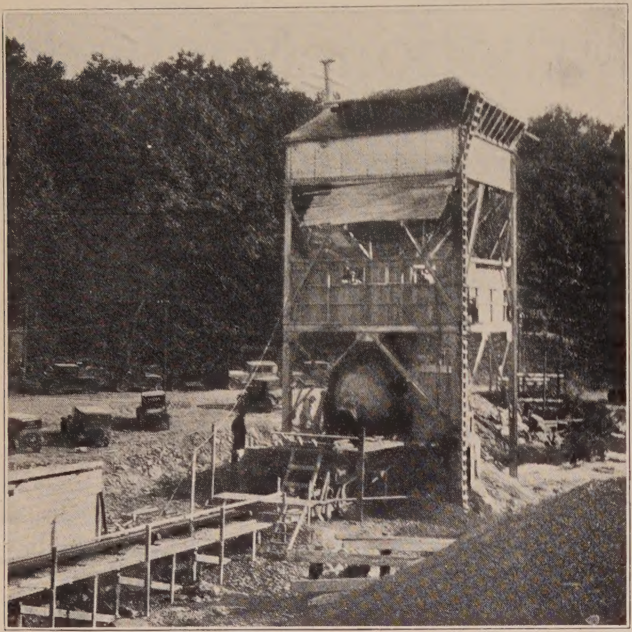
Figure 2. Concrete mixing plant discharges into hopper that feeds belt conveyor

After a full minute mix the batch was dumped into a bin which in turn fed directly to a belt conveyor. One man was constantly on duty at the bin gate to keep an even flow of wet concrete feeding from the bin to the belt. The first belt was 24 in. wide and 840 ft. long (Figure 4). This belt carried the concrete to the top of the hill, slightly above the top level of the dam where it discharged to a second belt, running at right angles to the first.

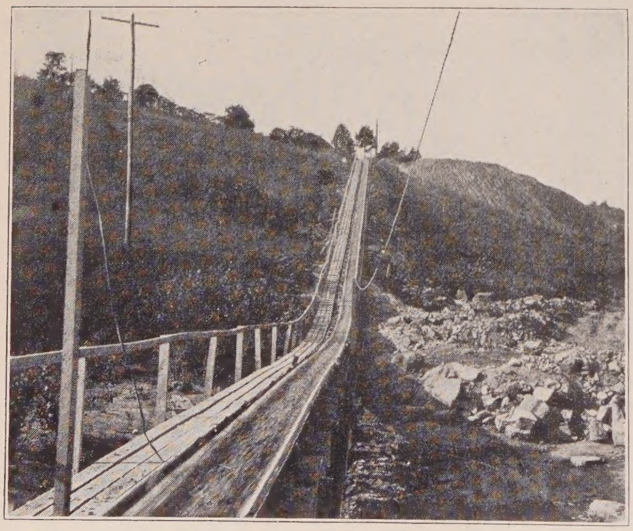
Figure 3. Eight hundred forty-ft. belt conveyor, as seen from concrete mixing plant

The second belt carried the concrete out to the dam. Here a tripper unloaded the belt, either direct to chutes which handled the concrete for the central portion of the section being placed, or to a short secondary belt carried on a traveling crane. This took care of the outer faces of the dam, or the more inaccessible portions of the center part. Both Insley and Ransome counterbalanced chutes were used for this work. Figure 4 shows the main belt feeding the distribution belt, which in turn was discharged close to the inner end, or center of the lift. In all, 1,900 ft. of belt conveyors were used.

Placing the Concrete

Concrete was placed in stages averaging 7 ft. high, two 8-hr. shifts having been used. Forms were made up in units and bolted into place. The form units were raised by block and tackle attached to the crane or belt rails and columns. The outer and inner faces of the dam are of 1:2:4 concrete, while the body of the mass is a 1:3:6 mix. Whistle signals were depended upon to indicate changes in the mix, and sufficient time was allowed at the mixing plant for the concrete on the belt to be placed and arrangements made at the dam for placing the new mix as desired. No difficulty was experienced with this system, and the work progressed in an orderly and efficient manner.

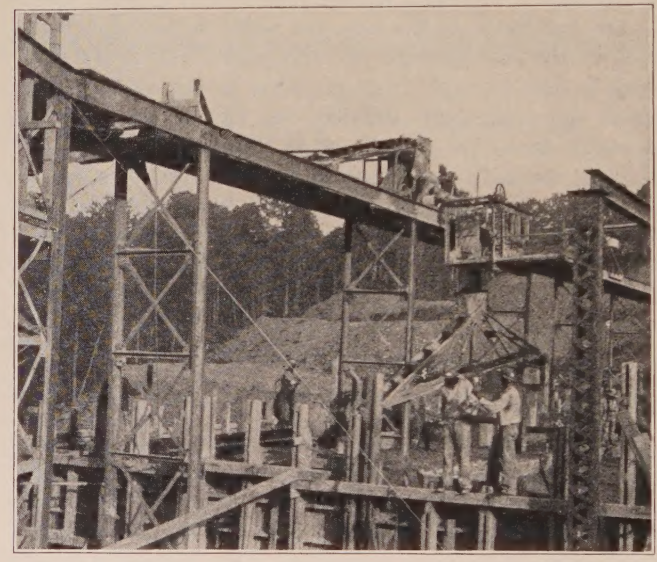
Figure 4. Where main belt delivers concrete to distributing belt and chute

Great care was used in placing the concrete to avoid segregation and to insure maximum density. Spading was required at all times. Before a new lift was started the sides of the two lifts between which the new one was placed were given a heavy coating of asphalt, the keyways were carefully cleaned, and the heavy copper waterproofing seal strip was straightened. The surface on which the fresh concrete was to be deposited was thoroughly chipped, brushed and washed, and given a thin coat of grout before fresh concrete was placed. Concreting operations continued until the lift was completed.

A total quantity of 102,000 cu. yd. of concrete was required to complete this dam. Two eight-hour shifts of 225 men each made up the full crew, and the work was completed well under scheduled time. The Northpoint Sand and Gravel Co., of Northpoint, Long Island, handled the construction. The design and supervision were supplied by the city of Wilmington. I. F. Storey was resident engineer in charge for the city, and W. J. Sims was superintendent of construction for the contractor.

Fireproofing Steel-Framed Buildings With Cinder Concrete

Erection of Form Work Described and Illustrated—Use of Stock Sizes of Material—Average Six Re-Uses of Form Lumber

By J. ARTHUR GARROD
Superintendent of Construction, Boston, Mass.

In this second article of a series running through three issues, the writer describes and illustrates in detail the manner in which the form work is placed for the fireproofing of steel-framed buildings. An important feature of this work is the use of stock sizes of lumber, readily obtainable, and the number of re-uses obtained.—*The Editors.*

THE previous installment of these articles, printed in last month's issue, described the nature and scope of the work involved in the fireproofing of steel-framed buildings in New York City, the location and erection of the fireproofing contractor's hoist, and the general methods employed. In the present article the construction and erection of form work will be discussed and illustrated.

Suspended Staging in High Stories

In high stories, where the cost of staging from the floor below would be prohibitive, it is customary to provide a suspended working stage entirely separate from form hangers, for the use of the form builders. For this purpose, loops of No. 6 wire are attached to all steel beams. These are placed in regular lines about 6 ft. apart. Spruce scantlings 2 by 4-in. in size and 14 ft. long are passed through these loops to form continuous lines of supports. Planks of 2-in. material and 14 ft. long, resting on the 2 by 4-in. ledgers, complete a safe and adequate scaffold for the form builders' use. The ledgers are left in place and in due time are again utilized for stripping the forms and doing any necessary pointing. The planks and ledgers are taken down after this use, but the wire hangers remain in place until they are removed by the fireproofer's men from the plasterer's stage.

In stories of all heights, the next and the primarily important operation is the hanging of the "joists," as the men call them. These consist of 1 by 4-in. rough-sawn full-thickness spruce, placed on edge. The hanging medium is a "hairpin" wire hanger, supplied to the job ready bent. Their use can be better understood by reference to Figure 1.

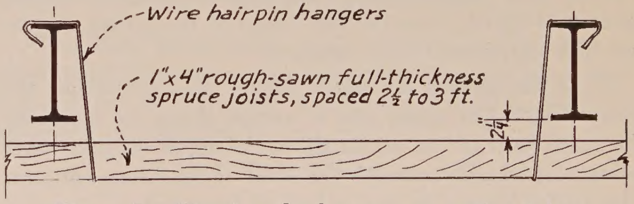
Wire hairpin hangers
1"x4" rough-sawn full-thickness spruce joists, spaced 2½ to 3 ft.
2¼"

Figure 1. Hanging the bottom supporting joists

The "hairpins" for supporting the joists are placed on one side of the steel beam only, so as to allow the beam bottoms to be slipped into place under the steel beam.

The "joists" are spaced 2½ to 3 ft. center to center and eventually support the beam bottoms, the beam sides, and the floor form system. Any necessary cutting of joists to length is done by the carpenter. The preparation of the "hairpins" is done in the shops of the wire supply houses. The hanging of joists is therefore considered to be laborers' work, and is paid for accordingly.

Construction of Girder Bottoms

The ⅞-in. girder bottom is usually of short leaf pine and is in one width. It is cleated at intervals of approximately 3 ft., with a 1-by-4 or 1-by-5. These cleats are spaced so as to avoid the intersection of a beam with a girder, since they could not be hung with a stirrup at that point.

After the cleats are nailed to the underside of the girder bottom, holes are bored through it on diagonally opposite sides of the cleats, and made-on-the-job wire hangers of required length are inserted and prevented from dropping out of place by a small nail through the cleat.

The required 2 in. of fireproofing is obtained by the use of double headed spacer nails. Two of these nails are driven into the girder-bottom in the neighborhood of each cleat, so located as to come under the edges of the bottom flange of the steel girder. The girder bottoms are prepared by the carpenter in readiness for their placement by helpers.

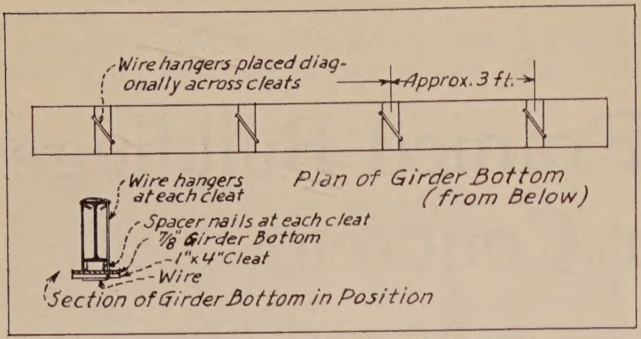
Wire hangers placed diagonally across cleats
Approx. 3 ft.
Wire hangers at each cleat
Plan of Girder Bottom (from Below)
Spacer nails at each cleat
7/8" Girder Bottom
1"x4" Cleat
Wire
Section of Girder Bottom in Position

Figure 2. Plan and section of girder bottom

Placing the Girder Bottoms

In placing the girder bottoms, one man straddles the girder near one end. The pair of wires next to that end are bent out to give the top man a secure hold. Then that end of the girder bottom is passed up to him by the man on the floor below. The top man grabs the loop of wire and pulls the girder bottom into place, and the man below lifts the other end into place with a piece of light lumber. The top man then secures all the wires in turn by bending their ends tightly over the top flange of the girder, by the use of a carpenter's claw hammer.

When the girders are much deeper than the beams the girder bottom is made into a trough shape by attaching the lower part of the girder-sides, the depth of these sides being just enough to reach the level of the beam bottoms. The girder bottom is then raised and secured in place, as described previously.

Placing Beam Bottoms and Sides

The 7/8-in. N. C. pine beam-bottoms are next placed. They rest upon and are secured to the "joists" first described. Since the girder bottoms and the supporting hanger joists (see Figure 1) are already correctly located, the beam bottoms can be correctly placed at once. The form is now ready to receive the beam sides and the upper part of the girder-sides, which are of the required length to reach from beam side to beam side. When the girder is of any considerable depth, the upper beam side is provided with cleats extending down to the girder bottom. Besides being nailed to the girder side, the lower end of the cleat is nailed to the girder bottom.

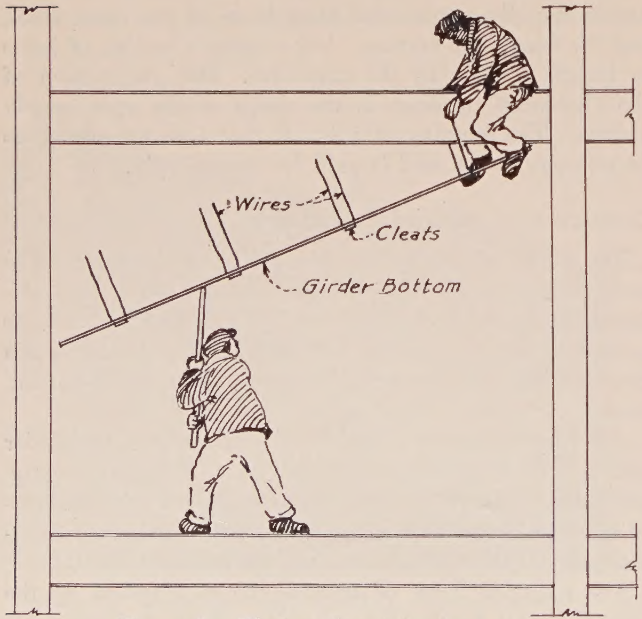

Figure 3. Placing the girder bottom

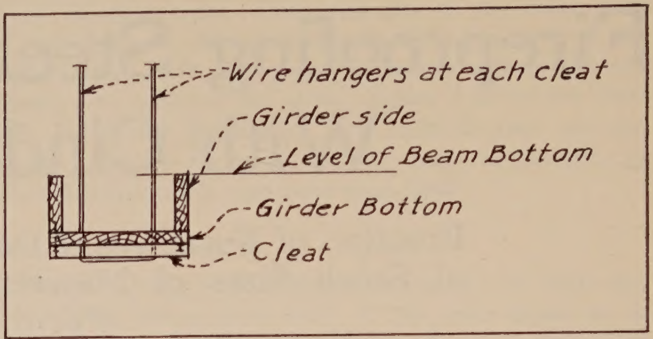

Figure 4. Section of girder bottom where girder is deeper than beams

The ribbands on the beam-sides are kept 2 in. short, so that a wedge against their ends will help to hold the upper girder side in place. The ends of the beam sides are lightly nailed to the end of the upper girder side to help hold it in place. Using the least possible number of nails, thereby making stripping easier and decreasing the destruction of lumber, was always a prime objective in all the items of form building.

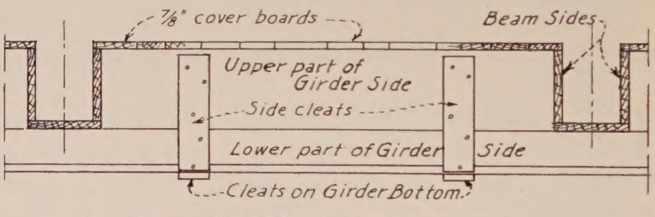

Figure 5. Elevation of girder side

The 7/8-in. N. C. pine beam-sides are prepared by the carpenter with 7/8 by 4-in. or 5-in. cleats spaced about 3 ft. center to center. To these cleats the 7/8 by 4-in. or 7/8 by 5-in. ribbands are nailed for supporting the 1 by 4-in. spruce spreaders. (See Figure 6.)

Spreader Joists Supporting Slab Forms

This upper tier of supports (called "spreaders" by the form builders) is of 1 by 4-in. rough-sawn full-thickness spruce. They are made about 2 in. too long, so that when placed on the ribbands from beam side to beam side, they are not at right angles to the beam sides. They are spaced as regularly as the form builder can place them "by eye," without the use of a rule or measuring device of any kind. As the spreaders are set angling to the beam sides, they can be stripped very readily, with no appreciable injury to the form stock. These spreaders also allow slight irregularity in the spacing of beams without cutting.

The spreaders are frequently used spliced, by lapping one piece of lumber by the other and nailing the splices. The objective of utilizing to the utmost every piece of lumber capable of service, is consistently followed in this part of the work.

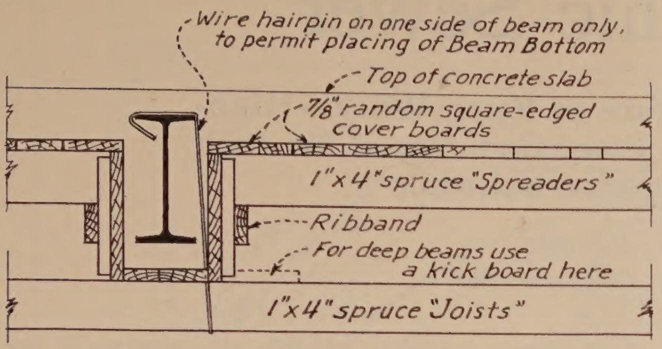
Wire hairpin on one side of beam only, to permit placing of Beam Bottom
Top of concrete slab
7/8" random square-edged cover boards
1"x4" spruce "Spreaders"
Ribband
For deep beams use a kick board here
1"x4" spruce "Joists"

Figure 6. Section through beam form

When Floor Slab Boards Are Too Short

The cover-over boards for the slab forms are usually N. C. pine, square edged, one side surfaced, and random widths, but ordered in the nearest obtainable length to the opening to be filled. The boards are used loose (not made into panels), and where necessary they are nailed occasionally to a spreader. If boards, as delivered, were 12 ft. long and the space to be covered in measured 13½ ft., then intermediate spreaders would be used and the cover-in boards laid in the opposite direction (see Figure 8). At the joint where the direction of the boards is reversed, iron plates are used to cover the joint. These plates are of No. 14 gauge, 8 in. wide and from 2 to 2½ ft. long. They are secured in place by a few short nails through holes near their ends. They are used many times and last for several jobs.

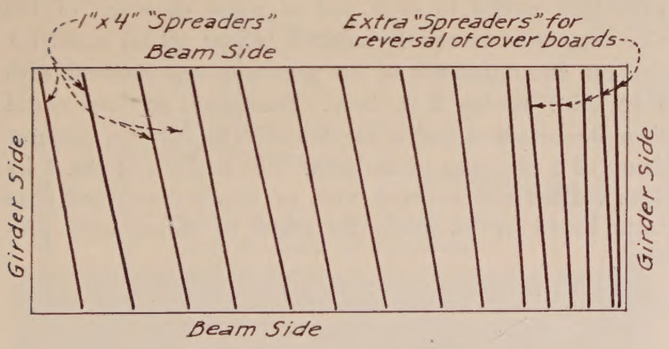

Figure 7. Plan of floor bay, with "spreaders" in place

Providing Rough Surface for Plaster

All beam, girder, and cover-in boards are used with the rough side to the concrete, so that the cinder concrete laid against such boards may afford a key for the direct application of plaster. No form oil is used on these forms.

Six Uses of Lumber

It is stated by the contractors and their foremen that form lumber will average six uses. As all types of form lumber are kinds and sizes stocked by the lumber yards, it is always possible to replace any type or size which wears out, and to use the bulk of the material to the utmost.

It is noticeable that throughout the forming for cinder concrete fireproofing absolute reliance is placed upon the wire hanger for suspending forms. Only in very special cases are posts from the floor below utilized as a supporting method.

The fireproofing of columns, except in unusual instances, is not handled by the contractor for concrete floors, but is accomplished by the mason by the use of building units of tile, cinder blocks, gypsum blocks or brickwork. In consequence, the general procedure on column forms is not discussed in this article.

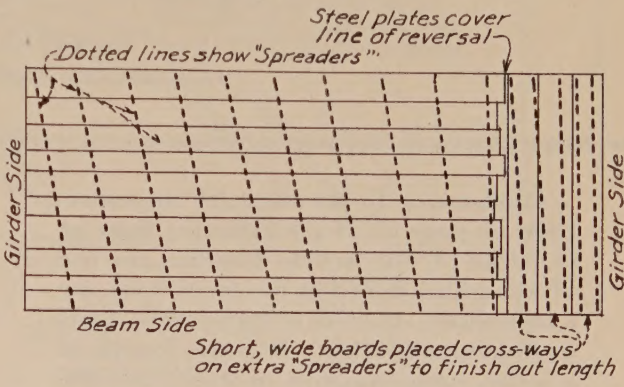
Steel plates cover line of reversal
Dotted lines show "Spreaders"
Girder Side
Girder Side
Beam Side
Short, wide boards placed cross-ways on extra "Spreaders" to finish out length

Figure 8. Plan of floor bay with reversed direction of boarding

(The final installment will describe the placing of steel reinforcement, the proportioning, mixing and placing of concrete, the stripping of forms, and the finishing of surfaces.)

Admixture Manufacturers' Group to Hold Meeting in Washington

Second Meeting Scheduled to Be Held Prior to American Concrete Institute Sessions; Round Table Discussion

The association formed in 1931 to represent manufacturers of integral waterproofing, hardeners, accelerators, special cements and workability admixtures, and to prepare a classification and specifications for these products, will hold its second meeting on Tuesday, March 1, at 9:30 a. m., at the Wardman Park Hotel, Washington.

Since this meeting is to be held just prior to the opening of the annual convention of the American Concrete Institute, it is hoped that all manufacturers of these products will have representatives present.

The meeting is to be a round table discussion in conjunction with members of the advisory committee of the A. C. I. The association of manufacturers is co-operating with Committee No. 110 of the A. C. I., which is to investigate and report on the entire subject for the Institute.

Further details regarding the meeting and the manufacturers' association may be obtained from R. E. Withrow, 1002 Engineers Building, Cleveland, Ohio. His convention address will be Room 100A, Wardman Park Hotel, Washington, D. C.

Form Work and Concreting Methods On Monolithic Sewer

Wood-Fibre Board Was Feature of Form Work—High-Frequency Electric Vibrators Place Concrete of 2½-Inch Slump—The Concreting Schedule

By HAROLD L. ANDRUS
Assistant City Engineer, Kalamazoo, Mich.

Conforming to the editorial announcement on page 21 of the February issue of CONCRETE, this article describes the use of wood-fibre board in the form work for a monolithic concrete sewer recently built in Kalamazoo, Mich. It is the fourth of a series, each complete in itself, describing the use of fibre board in concrete form work.

Another feature of this project was the use of electric high-frequency vibrators in placing concrete having a low slump. Concreting operations are described in detail.—The Editors.

DURING 1925, a complete study of the sewage disposal problem in Kalamazoo was made, with respect to its relations to existing sewage works, probable population increases, gaugings of flow, and possible locations and types of disposal works. Under the direction of the city engineer a report was prepared of the data collected. George S. Pierson was engaged as consultant and under date of 1927 he prepared complete plans for a sewage treatment plant and intercepting sewers. In 1931 the city commission ordered the first unit of the intercepting sewer built.

Nature of Design

This unit includes 319.38 ft. of rectangular outfall sewer from the plant to the river and 3,435 ft. of circular section from the outlets at the Gull Street bridge to the site of the plant. The unique features of the project are in the construction methods used to procure a monolithic concrete barrel in the circular sewer without longitudinal construction joints through the walls of the sewer.

Open Cut With Sloping Banks

The sewer was constructed in an open cut and without sheathing or bracing of the trench, the cut being made wide enough to allow the banks to be trimmed to a safe angle of repose. Ground water was conducted to a previously prepared sump by 12-in. tile drains laid at a grade beneath the bottom of the main sewer, and pumped to the river.

To maintain a regular schedule of concreting it was planned to provide as much form work as could be handily concreted in one working day, and stripped and reset in one day, bringing the number of concreting runs to three a week. A length of 96 ft., or twelve 8-ft. sections, was estimated as proper, but due to the facility with which this length was handled it was later changed to 14 sections of 112 ft. This schedule was maintained throughout the duration of the job.

Construction of Forms

The circular or inside forms were made by sawing 2 by 12-in. No. 1 y. p. lumber into circular segments of 26-in. radius and trimming the ends at an angle of 45 deg. to the chord, so that four of these segments could be laid on the floor in a circle 52 in. in diameter, with a space between the ends of each pair of segments equal to two thicknesses of 2-in. lumber. Two-by-eight's, 8 ft. long, were then nailed to each end of a set of seven of the circular segments equally spaced (about 16 in. c. to. c.) and the circumference of the segments was covered with 1 by 3-in. lumber 8 ft. long. Four such sections could then be bolted through the 2-by-8's to form a circular drum of a diameter of 56¾ in. The surface of the 1 by 3-in. lumber was covered with an impervious wood-fibre form board ⅛ in. thick, the edges of which were pro-

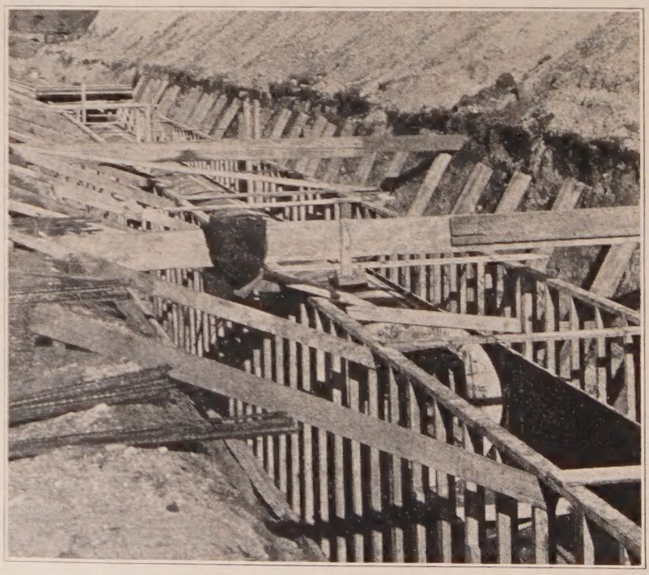

Figure 1. Form construction for monolithic concrete intercepting sewer, Kalamazoo, Mich.

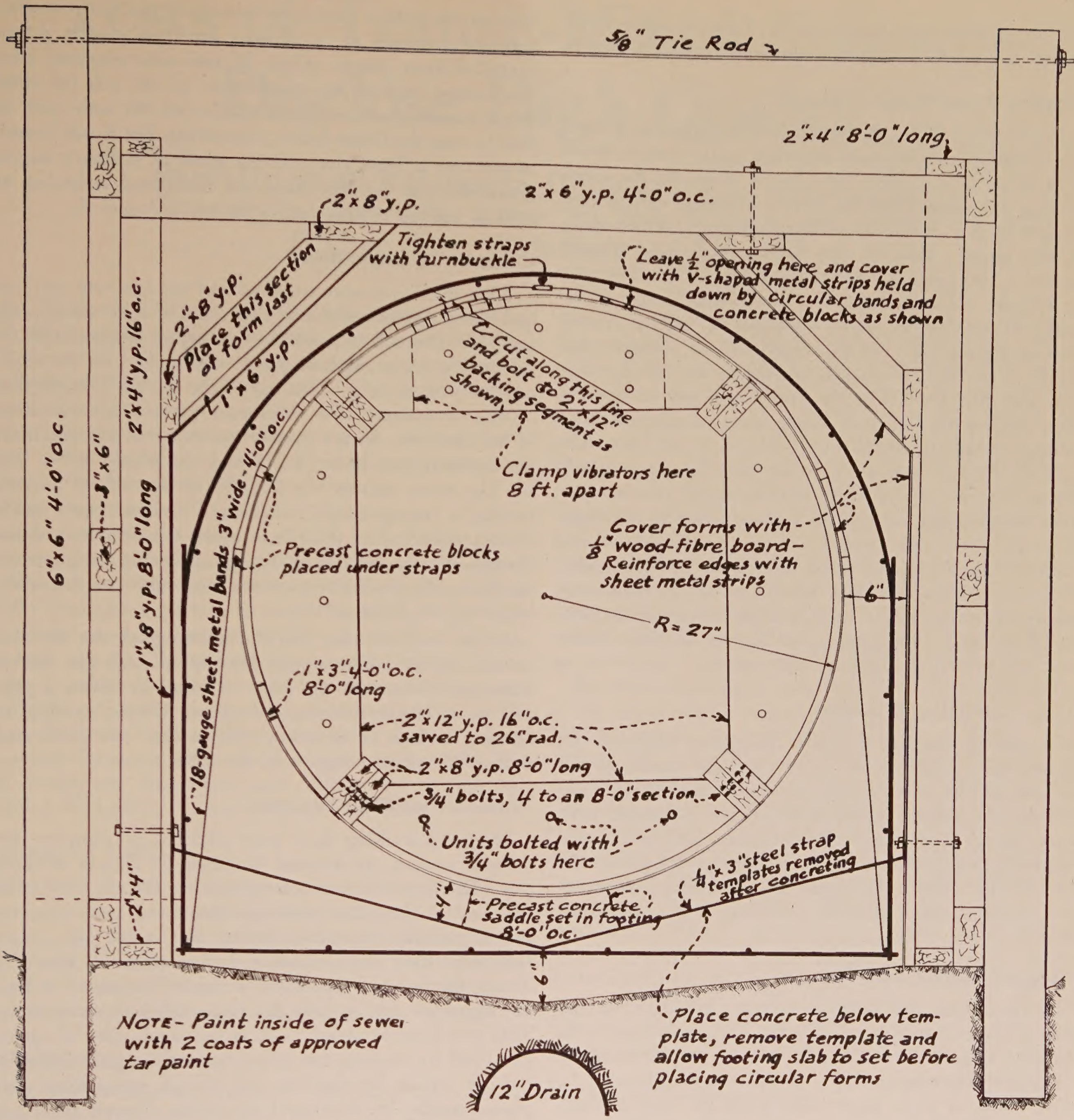
5/8" Tie Rod
2"x4" 8'-0" long
2"x6" y.p. 4'-0" o.c.
2"x8" y.p.
Tighten straps with turnbuckle
Leave 1/2" opening here and cover with V-shaped metal strips held down by circular bands and concrete blocks as shown
2"x8" y.p.
Place this section of form last
1"x6" y.p.
2"x4" y.p. 16" o.c.
Cut along this line and bolt to 2"x12" backing segment as shown
6"x6" 4'-0" o.c.
3"x6"
1"x8" y.p. 8'-0" long
18-gauge sheet metal bands 3" wide - 4'-0" o.c.
Clamp vibrators here 8 ft. apart
Precast concrete blocks placed under straps
Cover forms with 1/8" wood-fibre board - Reinforce edges with sheet metal strips
6"
R = 27"
1"x3"-4'-0" o.c. 8'-0" long
2"x12" y.p. 16" o.c. sawed to 26" rad.
2"x8" y.p. 8'-0" long
3/4" bolts, 4 to an 8'-0" section
Units bolted with 3/4" bolts here
1/4"x3" steel strap templates removed after concreting
4"
Precast concrete saddle set in footing 8'-0" o.c.
2"x4"
6"
NOTE - Paint inside of sewer with 2 coats of approved tar paint
Place concrete below template, remove template and allow footing slab to set before placing circular forms
12" Drain

Figure 2. Details of form work for monolithic intercepting sewer

tected with sheet metal strips nailed to the forms around all corners. Bolt holes were accurately spaced to make each section interchangeable and to allow a circular drum 54 in. in diameter to be formed in four sections, and also to allow each drum to be bolted to another to form a continuous circular form 112 ft. long.

Stripping the Interior Forms

To provide for stripping the forms from within the barrel of the concrete sewer after placement of the concrete, the top section (being placed with the chord horizontal) was sawed into two parts on an angle of 30 deg. with the horizontal. Inasmuch as the 2 by 8's contacted at an angle of 45 deg. with the horizontal, the lower part of this section formed a wedge which would fall from the surface of the concrete. The 2 by 12-in. circular segments thus sawed were held together by bolting to another 2 by 12-in. backing segment. In practice it was found necessary to hold the 1 by 3-in. covering strips ½ in. apart at the cut in the top segment to facilitate the removal of the forms. This crack was covered with loose strips of 20-gauge sheet metal to prevent concrete entering the crack. The metal strips were removed after each concreting operation and used again.

The walls of the sewer as designed were 6 in. thick and were reinforced by ½-in. deformed bars around the segment, and longitudinally. The outside section was modified somewhat from the designed shape to facilitate construction, the top half of the exterior being a hexagon and the bottom half a square. This allowed vertical outside form panels to be used and a removable slanting section to form the sloping sides of the hexagon. This outside form was provided to the amount of 224 lin. ft.

Holding Form Work in Place

In practice 112 lin. ft. of the outside form was placed, and a slab of concrete was deposited in the bottom about 6 in. thick in the center and 12 in. thick on the sides, making a V-shaped footing. In this footing were placed the bottom steel and short rods extending up into the walls of the sewer. Also, in the footing slab, and hooked around a longitudinal reinforcement bar at 4-ft. intervals on opposite sides of the sewer, sheet metal straps of 20-gauge material 3 in. wide were placed with a riveted loop at the top end. These straps were of a length that would allow them to be placed around the circular section when the latter was set, and drawn taut to form a band holding the circular section down during the concreting. Small tile saddles were placed at 8-ft. intervals upon the footing slab, at the invert elevation, upon which the circular section of form rested. Small precast concrete blocks about an inch thick were nailed to the form under the sheet metal straps to hold the latter from the surface of the form, and allow the concrete to flow under the strap to form a smooth interior surface. Each concreting operation was a unit, and the construction joint was closed with an expanding metal dam to allow movement and prevent an opening in the sewer.

Daily Concreting Procedure

In placing concrete the daily procedure included the concreting of 112 lin. ft. of footing slab ahead of the circular section, and 112 lin. ft. of circular section. The next day the outside forms of the section completed were moved ahead of the newly placed footing, and the circular forms were stripped and set on the footing slab placed the previous day. On the third day the concreting operations were repeated, thus completing 112 lin. ft. of sewer every other day.

Vibrate Concrete Into Place

In concreting the circular section, vibrators of the electric motor unbalanced weight type were used with complete success. Six vibrators were in use, operated by a gasoline-driven generator. Vibrators were placed 8 ft. apart, clamped to the upper segment of the circular form on the inside. Four were operated at the same time. No difficulty was encountered in flowing a mix having a slump of 2 to 3 in. completely around the circular section of the form, with a minimum of water pockets and honeycomb spots. It is our opinion that without the use of the vibrators we would have been unable to place a workable mix around the circular form.

The motor in the vibrators is a 220-volt, 3-phase, 60-cycle motor of the induction type. The only revolving part in the motor is an eccentric rotor whose motion sets up the vibratory action of the unit, with a frequency of about 3,600 r.p.m.

Wood-Fibre Board Used 36 Times

Excellent service was also obtained from the fibre board used, as we did not replace the covering on the outside forms during the entire progress of the work, these forms having been used 36 times. The interior or circular forms were covered once during the work, as the first covering was not protected at the corners or edges, and it deteriorated at those places. About 25 uses were obtained after the change, and at the completion of the job the fibre board was in good condition. Different oils were used at first to coat the forms before concreting, but it was found, in our case at least, that a cheap grade of ordinary wagon grease formed the best film and facilitated stripping as well as making a smoother finish on the concrete.

Concrete Is Impervious

After the forms were removed and the concrete surfaces had become sufficiently dry, two coats of a tar paint were applied. There is a possibility of septic sewage, and resulting hydrogen sulphide gases combining with the moisture to form an acid in the top of the sewer. The purpose of the tar coating was to prevent possible deterioration of the concrete. A very impervious concrete was obtained, the nominal mix being 1:2:3 and the slump about 2½ in. The water content was 5½ gal. to the sack of cement, making a strong, tough concrete. Provisions were made at the upper end of the job to allow the diversion of the sewage into the river at that point, allowing complete inspection and possible repainting and repair of the entire length of the 54-in. section.

At the end of each day's concreting of the circular section an expanding copper dam was placed, and the reinforcing was cut at the joint to form, in effect, a pipe 112 ft. in length that could contract without causing an opening or leak in the sewer. No cracks were discovered during the entire progress of the work.

Provision for Cold Weather

Sixty-five working days were required to complete the circular section, an average of about 53 ft. per working day. The first concrete was placed on Oct. 3, 1931, and the last on Dec. 22. Although the season was late, excellent weather prevailed during the entire job. Only four days were lost because of bad weather. It was only during the last two weeks that it became necessary to heat the aggregate and to heat the forms after the concreting. This was done by steam lines at the stock piles of aggregate, and by running the mixer water through a boiler at the job. After the concrete was placed, steam lines were placed inside the forms and the whole covered for 12 to 14 hours. No difficulty was encountered in removing the forms on the morning following concreting on the previous day.

The interceptor as constructed conducts to the site of the disposal plant about 70 per cent of the sewage of the entire city, from approximately 60 per cent of the area of the city.

Acknowledgments

The work here described was designed and built under the direction of E. S. Clark, city engineer of Kalamazoo. George S. Pierson, of Kalamazoo, was consulting engineer. The wood-fibre board used is known under the trade name of "tempered presdwood," manufactured by the Masonite Corporation, of Chicago, and the electric power-driven vibrators were supplied by the Electric Tamper & Equipment Co., of the same city. The writer was in direct charge of the construction operations.

Tests of Transit-Mixed Concrete Disclose High Quality

Runs Up to 90 Minutes in Hollister Tests Show Little Change in Strength After 40 Revolutions—Strength Higher Than With Ordinary Mixing

THE development of central mixing plants, both for the production of ready-mixed concrete for sale, and for the use of contractors on large operations, has resulted in focusing attention to plant layout, and to mixer design. From these considerations there has developed a new mixing device—the transit mixer—with operating functions different from the stationary mixer, and with new mixing principles involved in its design.

This paper reports the tests of a variety of concrete mixtures made in 1-, 2½-, and 4-cu. yd. Jaeger truck-transit mixers, the mixing time in some cases extending to 90 minutes. The fresh concrete was analyzed by means of the Dunagan apparatus to study the degree of uniformity of the concrete sampled at various periods of mixing. At each period of sampling, cylinders were molded, three being tested at each of 7 and 28-day ages; additional sets of three each are in storage to be tested at the age of one year. The tests were conducted under the author's supervision at Columbus, Ohio, during the summer of 1931. In all, twenty-two runs were made with transit mixers, involving the making of more than 800 cylinders.

Purpose of Tests

The purposes of the tests were (1) to determine the relation between the strength of the concrete and the time of mix; (2) the relation of time of mix to the degree of uniformity of the concrete produced; and (3) the relation of other observable features of the mixing operations to both strength and uniformity of output.

Acknowledgment

The author especially acknowledges the assistance of Prof. R. B. Crepps, of the materials testing laboratory of Purdue University, who made all of the wet analyses, and who gave valuable assistance throughout the tests. Grateful acknowledgment is also due C. B. Williams, who assisted in the tests and in reducing the data.

Description of the Mixers

The Jaeger transit mixer consists essentially of a drum mounted on a truck chassis, in which drum the concrete is mixed while being transported over the highway. The drum differs in form from the customary mixer drum in that, in proportion to its diameter, it is much longer in the direction of the axis of rotation.

The arrangement of the blades in the drum is of particular interest. The main blade is a spiral attached to the periphery of the drum. At the rear end this blade widens until it very nearly reaches the axis of rotation. At the rear end also, the shell of the drum tapers from a cylinder into a truncated cone terminating at the circular rear gate. The widened spiral at the rear plays an important function during the mixing action; and when the drum is reversed in direction of rotation, this blade engages a large mass of concrete, carrying it to the rear for discharge.

At the front end of the drum there are two blades inclined approximately 45 deg. to the axis of rotation with their pitch sloping inward to the rear. These blades are called the "throw-back" blades, and they too perform an important function in the mixing action.

Repeated observations disclosed that, due to a portion of the spiral blade being imbedded underneath the mass of wet concrete, the concrete was carried up as the drum rotated. At a certain elevation this concrete then tended to roll or slide across the drum to the opposite side. As this sliding action was about completed, the broad portion of the spiral blade at the rear would reach an elevation such that the mass of concrete it engaged would be forced by a sliding action diagonally across the drum to the opposite side at the forward end. As the drum rotated still further, a similar mass engaged by the elevating throw-back blade would be forced to slide diagonally across the drum and to the rear. The general action was one of a crosswise rolling and sliding motion, coupled with an immediately following criss-cross action. The mixing action took place within the mass of the batch.

Method of Charging Mixers

Batching was accomplished by the use of a 2-compartment overhead hopper discharging directly into a 2-compartment weighing hopper. Sand and gravel were batched by weight, the weight in each case being approximately corrected in advance for moisture content on the surface of the particles. During the process of discharging from the hopper into the weighing hopper, samples of each aggregate were taken, upon which accurate determination of surface moisture was made.

Because the quantity of gravel in the weighing hopper exceeded the quantity of sand corresponding to it in the batch, the sand was completely discharged from its compartment before the gravel compartment was emptied. In this way there was bound to be a separate layer of gravel on top of the portion of combined aggregate that could be ribboned together during discharge.

The reason for adopting this method of ribboning the sand and gravel, was that it is a practical field method

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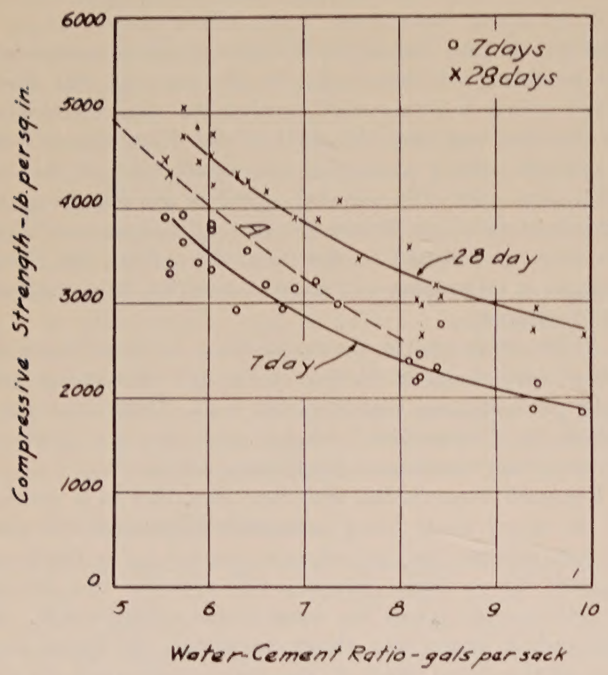
Condensed from paper to be presented by S. C. Hollister, professor of structural engineering, Purdue University, at the 28th annual meeting of the American Concrete Institute, Washington, D. C., March 1-4, 1932.

inasmuch as this type of weighing device for batching purposes is now generally a part of the contractor's equipment.

Stronger Than With Ordinary Mixing

A number of tests of concrete mixed in the ordinary stationary type of mixer for one minute, but otherwise corresponding to batches mixed in the transit mixer, were made; but the range of such tests was not large enough to be reported here. These tests indicated that the strength of concrete mixed 40 or more revolutions in the transit mixer was higher than similar mixes from an ordinary mixer after one minute of mixing.



Relation between compressive strength and water-cement ratio in all transit-mixed concrete tests

The Effect of Regauging

It was found during the conduct of the tests that the mixtures at first grew more workable and then, as mixing was further prolonged, increased in stiffness and at the same time appeared to increase in fatness. This experience accords with that of Professor Slater in his test of a rotating drum agitator.[1] It was also found that some of the stiffening effect could be accounted for by a tendency of the sand to be reduced in size during the mixing action. The author believes that some of the stiffening effect is due to the physical change in the cement itself during hydrating.[2]

Conclusions

Within the conditions of these tests the following conclusions appear to be justified:

1. For practical ranges of mixtures, and regardless of mixer speed, 40 revolutions of the drum adequately mix the batch when the charge is introduced by ribbon loading, and 60 revolutions of the drum properly mix the batch when the charge is placed by laminated loading.

2. The speed of the mixer appears to have no effect upon the thoroughness of mixing or upon the strength obtained for mixing periods of 40 revolutions of the drum or more when the charge is placed by ribbon loading.

3. So long as the mix remains workable there appears to be no variation in strength for mixing periods varying from 40 revolutions of the drum to 1½ hours of mixing. Tests were not conducted beyond the latter period.

4. There appears to be a regular relation between strength of concrete at 7 and 28 days and water-cement ratio. The relation appears to be of the same form as for other usual methods of mixing. The strengths, however, seem to be somewhat above those commonly obtained with the usual one minute of mixing.

5. Tests show that where water was added during the course of mixing to improve workability, the strength of the regauged concrete bore the same relation to the water-cement ratio after regauging as though the mixture had originally been made with that water-cement ratio.

6. Overloading of this transit mixer required special charging methods and a longer minimum mixing time than 40 revolutions of the drum.

A. S. T. M. Group Committee and Regional Meetings at Cleveland

The standing committees of the American Society for Testing Materials will hold their annual Spring Group Committee meetings at Cleveland, Ohio, beginning Monday, March 7, and continuing through March 11.

The third regional meeting sponsored by the Society will be held in conjunction, on March 9.

Ready-Mixing Plant Operators Re-elect Burke

J. E. Burke, Pittsburgh, Pa., was re-elected president of the National Ready-Mixed Concrete Association during the meeting held at that city January 25 and 26.

Arthur C. Avril of Cincinnati was named secretary and V. P. Ahearn of Washington, assistant treasurer.

Coming Conventions

March 1-2 — Concrete Masonry Association, annual meeting. Wardman Park Hotel, Washington, D. C.

March 1-4 — American Concrete Institute, twenty-eighth annual convention. Wardman Park Hotel, Washington, D. C.

May 2-6—American Waterworks Association and Waterworks Manufacturers' Association, annual meeting, Memphis, Tenn.

June 20-24—American Society for Testing Materials, thirty-fifth annual meeting. Haddon Hall, Atlantic City, N. J.

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[1] Tests of Concrete Conveyed from a Central Mixing Plant.—W. A. Slater, *Proc.* A. S. T. M., 1931.

[2] Studies of Concrete Mixtures; A. C. I. *Journal*, April, 1931.

Resurfacing and Widening Methods Applied to Concrete Roads

Practices in Many States—Resurfacing Designs Tested in Actual Service—How Contracts Are Awarded—Keying Widening Strips to Old Pavement

THE practices followed in the resurfacing of old concrete roads are far from being standardized, according to letters received by CONCRETE from forty-one state highway departments. Even in the widening of existing concrete roads, where the strips or shoulders added are almost invariably of concrete, there is much variation in practice in matters such as thickness, and in the use or omission of reinforcement.

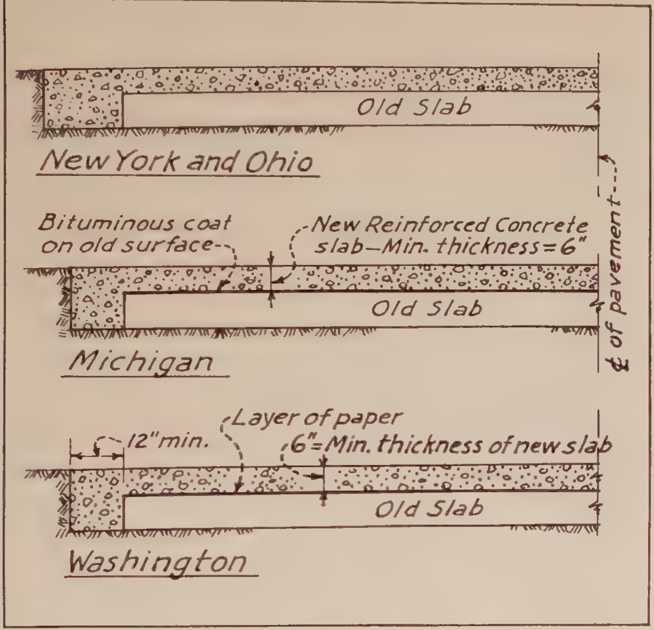

Old Slab
New York and Ohio
Bituminous coat on old surface
New Reinforced Concrete slab—Min. thickness = 6"
Old Slab
Michigan
℄ of pavement
Layer of paper
12" min.
6"= Min. thickness of new slab
Old Slab
Washington

Figure 1. Resurfacing methods employed in New York, Ohio, Michigan, and the State of Washington

Nineteen of the forty-one state highway departments reporting have had practically no experience with resurfacing or widening, the road construction programs not having developed to the point where work of this character is needed. Even in Texas, where the construction of the highway system is well advanced, Gibb Gilchrist, state highway engineer, writes that little reconditioning of old pavement has been necessary. "All of our pavement has been kept under very careful observation," he states, "and very little actual disintegration has occurred."

Many Use Bituminous Surfacing

Many states have used some form of bituminous material for practically all of their resurfacing work. These include Delaware, the District of Columbia, Massachusetts, New Jersey, West Virginia, Maryland, North Carolina, Georgia and Oregon.

In New Jersey, however, this type of resurfacing has not been found wholly satisfactory. "Certain old pavements," says R. B. Gage, chemical engineer, "have been given a surface application of bitumen and covered with chips. This method is inexpensive but not very satisfactory."

Practice in Resurfacing with Concrete

Still other states have resurfaced with both concrete and bituminous materials; but because of space limitations the remainder of this digest of practice will be confined to cases where the material used is concrete.

In California, states C. H. Purcell, state highway engineer, the practice is to place a sand cushion on the old slab, then superimpose a new surface course of portland cement concrete.

The resurfacing design used in Michigan, shown in one of the illustrations, is described by C. M. Ziegler, deputy

A cross-section of practice in the design and construction of concrete highways is contained in detailed letters and discussions received from highway engineering officials of forty-one states, in response to inquiries addressed to them by "Concrete."

A digest of these letters, the first of which is here presented, will bring valuable information to the attention of highway engineers, for each will see how others are handling the various problems.

The present article deals with the resurfacing and widening of concrete pavements. Others will follow in successive issues, on subjects such as the question of minimum cement content, the use of two or more sizes of coarse aggregate, experiences with the use and handling of bulk cement, the advantages of high-early-strength cement, centrally-mixed and truck-mixed concrete, tests and investigations based on experimental roads, other tests and investigations.

"Concrete" welcomes this opportunity to be of service to highway engineers, an opportunity which has grown out of the cooperative spirit displayed by those engineers who have contributed the discussions.—The Editors.

commissioner, Michigan State Highway Department, as consisting of a bituminous treatment applied to the surface of the old slab, which is then completely enveloped, both top and sides, with a minimum thickness of 6 in. of reinforced concrete.

The practice in Indiana, where resurfacing is accompanied by widening (See CONCRETE, September, 1930, pages 17-19), is to maintain a minimum thickness of 5 in. in the reinforced concrete slab placed over the old pavement. This type is shown in one of the drawings.

"Our practice in New York," writes E. C. Lawton, construction deputy, Division of Highways, "on roads which require an additional thickness, is to place on it a new wearing course." A similar practice is followed in Minnesota, the "second story" construction, as it is termed by J. T. Ellison, chief engineer of the State Department of Highways, being from 3½ to 4 in. thick.

How Resurfacing Contracts Are Awarded

"Resurfacing and widening an old concrete road in Ohio," writes Neal Moler, assistant engineer, bureau of construction, State Department of Highways, "usually calls for a reinforced concrete slab of thickness less than the standard. Contracts are awarded on a cubic yard basis and with a specified minimum thickness. Payment is made on cross-sections taken at intervals of 10 to 25 ft."

"Standard practice has not been developed in Missouri for the resurfacing of old concrete pavements," states T. H. Cutler, chief engineer, Missouri State Highway Department, "but during the year a test section was constructed in part of portland cement concrete and in part of various types of asphalt construction." The experimental sections referred to by Mr. Cutler are described in detail in the January (1932) issue of CONCRETE, pages 9-10. This experimental work includes two stretches of concrete resurfacing each ⅛ mile in length. The new slabs are 4 in. thick, reinforced with wire mesh. In one stretch the best possible bond with the old slab was obtained by scrubbing the old pavement and applying the new concrete to the wet surface. In the second stretch bonding was intentionally prevented by applying a coat of asphalt ⅛ in. thick to the old surface.

Experimental Resurfacing in Virginia

Virginia is trying out an experimental stretch of widening and resurfacing, 4.3 miles long, according to C. S. Mullen, State Department of Highways. The old pavement was in part 16 ft. wide and in part 18 ft. The new pavement has a total width of 22 ft., as shown in the drawing. The resurfacing slab, which is 20 ft. wide, is of reinforced concrete 4 in. thick, resting on a 2-in. sand cushion.

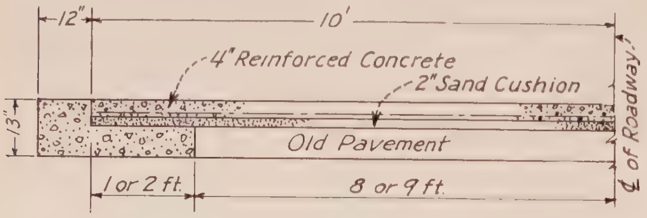


Figure 2. Resurfacing and widening section being tried out in Virginia

T. G. McCrory, chief engineer, Washington State Department of Highways, Olympia, Wash., writes that in their resurfacing and widening practice the redecking is not less than 6 in. thick and is separated from the old pavement by paper. The new pavement, wherever possible, is extended at least 12 in. beyond each edge of the old, so as to have a thickened edge in the reconstruction. Utah, likewise, maintains a minimum thickness of 6 in. in the concrete resurfacing slab, states H. S. Kerr, chief engineer of the State Road Commission.

Widening Practice

Where widening alone is involved, concrete roads are almost invariably widened with portland cement concrete, though in a few cases asphaltic concrete has been used.

The practice in Massachusetts, says R. W. Coburn, construction engineer, State Department of Public Works, is to build the widening slabs the same depth as the old slab, with a 1:2:3½ mixture reinforced with bar steel.

Keying New Strip to Old Pavement

In Pennsylvania, Wisconsin, and Washington, the widening slab is keyed 6 in. under the edge of the old slab, as shown in the drawings. Samuel Eckels, chief engineer of the Pennsylvania Department of Highways, states that both portland cement concrete and bituminous mixtures are used.

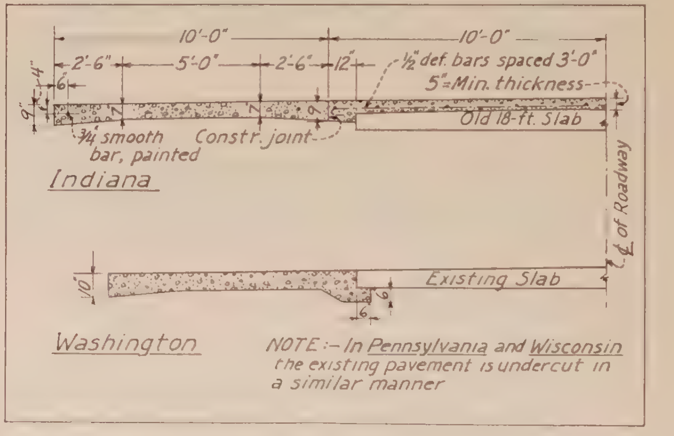


Figure 3. Resurfacing and widening design employed in Indiana, and widening practice in Washington

"Widening old concrete pavements in Wisconsin," says E. L. Roettiger, assistant construction engineer, Wisconsin Highway Commission, "is accomplished by excavating a small trench adjacent to and under the old pavement slab to form a key under the existing pavement. In some instances ½-in. deformed tie bars are driven under the edge of the old slab, and allowed to extend into the new pavement on each side."

The practice in Washington, says T. G. McCrory, chief engineer, State Highway Department, is to make the outer edge of the widening strip 10 in. thick, while the inner edge of the new strip, as shown in the drawing, is keyed under the old pavement for a distance of about 6 in. and a depth of the same amount.

(Minimum cement content will be the subject of the next article in this series.)

EDITORIAL

A Great Year for Concrete Masonry Units

IT seems paradoxical to say that an industry can attain its greatest achievements in a year of low production; yet that is precisely what happened in the concrete masonry industry in 1931.

In an address before the annual convention of the Wisconsin Concrete Products Association, W. D. M. Allan, manager of the cement products bureau of the Portland Cement Association, enumerated some of the outstanding events that occurred in this industry during the past year—events that greatly improved the standing of concrete masonry units in the minds of architects, specification writers, and owners.

Prominent among these events was the series of load tests and wall stability tests conducted at the University of Illinois, and the later presentation of the test results before the annual meeting of the American Society for Testing Materials.

Next came the adoption by the A. S. T. M. of the tentative standard specifications and methods of test for hollow concrete masonry building units. About the same time the Federal Specifications Board of the U. S. Bureau of Standards adopted a standard purchase specification for hollow concrete masonry units, a specification which is made mandatory on all purchasing offices in the departments and independent establishments of the federal government. The same Board, more recently, adopted a purchase specification covering cast stone.

In the most recent report issued by the U. S. Department of Commerce Building Code Committee, which appeared in the early part of 1931, under the title "Recommended Minimum Requirements for Fire-Resistance in Buildings," concrete masonry wall and partition units are given due recognition as fire-resistive materials.

The last year was, in these respects, a great year for concrete masonry units. The achievements just recounted will lighten the work involved in the development of wider markets for the old and the new products of this industry.

The Conventions in Washington

THE American Concrete Institute and the Concrete Masonry Association are opening their annual conventions in Washington as this issue of "Concrete" comes from the press.

Programs of exceptional value are to be presented at the separate and the joint sessions of the two organizations. Genuine accomplishment over a wide range of activities is reflected in these programs.

One lesson that the delegates to these conventions will surely learn is that the concrete construction industry is a living organism. It is an industry that grows, even in times of economic drought.

The conventions in Washington will be an inspiration to those who attend them.

Fight for Continued Highway Construction

LEADERS of the American Road Builders' Association, during the annual Road Show held in Detroit in January, frequently stressed the need for vigilance in matters not directly concerned with construction problems, if the highway construction program of the nation is to be pushed forward.

Developments since the time of the Road Show have proved that the warnings then issued were based on definite information concerning the trend of the public mind. As the A. R. B. A. leaders foresaw, the demands for continued public construction work as a means of relieving unemployment are being met by powerful opposing demands from taxpayers for reduced taxation. In several important states the taxpayers appear to be gaining the upper hand. Unless they can be convinced of the shortsightedness of such a policy, highway construction may be suspended in some states.

Serious as the foregoing situation may become, there is far greater danger in the tendency of state officials to find ways to divert the gasoline tax, the motor license fees and other special highway construction funds into the general fund. Once given a foothold, no one can predict how far political expediency will carry this misapplication of special taxes raised for special purposes.

The thing that so many state officials are overlooking is that motorists have tolerated, and even favored, the gasoline tax and automobile license fees only because it was understood from the beginning that the funds so raised were to be ear-marked for the construction of good roads. The instant that these special funds are diverted to other uses they become nothing more than "just another tax." What is to prevent the great body of motorists from starting a tax rebellion of their own, when they realize that the special taxes they are paying are not being applied to their intended uses at all?

The American Road Builders' Association has taken the lead in the effort to prevent the consummation of these evils. In taking this action that organization is performing a notable public service, one which deserves vigorous support and sincere cooperation from all individuals and organized bodies who believe in the soundness of the policy of uninterrupted highway construction.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Federal Specifications for Cast Stone Adopted

THE Federal Specifications Board of the United States Bureau of Standards has officially adopted a purchase specification covering architectural cast stone, based on data obtained in tests conducted by the Bureau. (See also CONCRETE, March, 1931, page 26.)

The full title and symbol of this new standard is Cast Architectural Stone (SS-S-721).

May 1, 1932, is designated as the mandatory date after which the purchasing offices of all departments and independent establishments of the government are expected to adhere to these specifications in the purchase of cast stone.

Copies of the new standard may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

To Demonstrate Concrete House Construction at Leipzig

A PROCESS has lately been perfected in Germany by which it is claimed to be possible to build small and medium buildings of concrete 42 per cent cheaper than when bricks are used. This is done with a casting device in which a layer of concrete, 10 in. deep, is tamped. Plastering is rendered superfluous, while an air space is secured at the same time. A house large enough for two families can be built from foundation to roof in 24 working days by this process, which will be demonstrated at the Leipzig Fair in the spring of this year.

Bureau of Standards Investigations of Cement and Concrete

ACCORDING to a summary of the U. S. Bureau of Standards investigations dealing with cement, masonry construction, lime, gypsum, and stone, under way during 1931, the following among the subjects under investigation are of interest to the concrete construction or cement manufacturing industries:

(1) Investigation of high-early-strength cements.

(2) Masonry cements.

(3) Reaction of water on the calcium silicates.

(4) Testing durability of cement by titration in sugar solution.

(5) Thermal decomposition of tricalcium silicate.

(6) The binary system $CaO\text{-}B_2O_3$.

(7) Reaction of water on the calcium aluminates and calcium aluminate cements.

(8) Temperature rise in cement pastes during hardening.

(9) Hardening of portland cements at the boiling point of water.

(10) Investigations of Portland Cement Association fellowship at the Bureau of Standards.

(11) Investigation of physical properties of cast stone.

(12) Waterproofing agents for concrete.

(13) Clays as admixtures in concrete.

(14) Investigation of cinder aggregates.

(15) Researches on the properties of masonry mortars.

Information concerning these investigations may be obtained by addressing the U. S. Bureau of Standards, Department of Commerce, Washington, D. C.

Tan-Colored Portland Cement Produced on Coast

A TAN-COLORED portland cement, intended for use in color work, as for stucco, cast stone, random ashlar units, flagstones, colored driveways and sidewalks, and related uses, is being produced by the Pacific Portland Cement Company.

This product is a true portland cement, which meets the standard specifications of the A. S. T. M.

Book of A. S. T. M. Tentative Standards Now Available

THE 1931 Book of A. S. T. M. Tentative Standards, mentioned on this page in the issue of September as being under preparation, is now off the press and available for distribution. The volume contains 1,008 pages and includes 180 tentative standards, 30 of which pertain to cement, lime, gypsum, concrete, or clay products.

The new volume, which also contains tentative revisions of 50 existing standards, is available in paper binding at a price of $7.00, or clothing binding at $8.00.

Estimating Construction Costs

FOR THE BENEFIT of men interested in preparing estimates of construction costs, a new course has been introduced by the University of Wisconsin Extension Division at Madison, Wis. In 20 assignments, this course, called "Estimating Construction Costs," will be offered to students in any state by correspondence study. It is intended for contractors and others doing construction work, for estimators, engineers, architects, and designers.

Professor H. E. Pulver, of the department of civil and structural engineering, is in charge of this course.

Concrete Irrigation Pipe

THE California Associated Concrete Pipe Manufacturers, Visalia, Calif., have issued a multigraph on the "Design, Construction and Operation of Concrete Pipe Irrigation Lines," under date of January, 1932.

The multigraph covers the design and construction of concrete pipe irrigation lines, the preparation of the trench, the laying and joining of the pipe, curing and protection of joints, and backfilling of the trench. Specifications and tests for concrete irrigation pipe are also included.

Spread Footings, Mat Foundations and Deep Foundations

Further Consideration of Footings and Foundations in Series on Inspection, Testing and Supervision of Concrete Work—Concrete Piles and Caisson Piers—Advantages and Limitations of Cast-in-Place-and Precast Piles

By RICHARD H. VOSE
Civil Engineer, Robert W. Hunt Company, Chicago, Ill.

This further study of footings and foundations deals with spread footings, mat foundations, and foundations carried to greater than ordinary depth, such as piles and caisson piers. It is the second of a series of seven articles on testing, inspection and field supervision of concrete work.

The five future articles will cover concrete, cement and reinforcing steel, the inspection and testing of aggregates, the making and testing of concrete cylinders, and field supervision.—The Editors.

THE object of spread footings is to increase the bearing area and so reduce the unit loads upon the soil.

In the simplest form a spread foundation as used in light building construction may be illustrated by a course of masonry or concrete placed in a shallow excavation and somewhat wider than the wall to be built upon it. As total loads increase, the bearing area must be increased and the footings become wider and deeper until the number and size of footings reach the point where they will overlap; and this condition indicates the next step in the continuous slab under all bearings and carrying the whole load of the building.

How Foundation Requirements Are Met

In all footings certain requisites must be met. The area must be sufficient to keep the unit load on the soil inside of the allowable limit. The footings must be bonded to the imposed wall or piers. The axis of the imposed load must, if possible, be exactly over the center of bearing area, and the footing itself must have strength to resist the transverse strains.

Many progressive forms of footing design are used to obtain these ends. The usual method of stepped-up footings is most familiar, and where there are no restrictions it is the most simple and economical. In such design it is possible to fulfill the requirement, and if designed with due regard to ratio of offset to rise, and if properly constructed, such footing will be satisfactory.

Where building lines limit the spread of footings, area may be gained by using rectangular bases with the long diameter parallel to the building line. In more exigent cases cantilever design is used for distribution of the loads.

The use of the inverted arch to gain area of distribution, once quite familiar, is now discouraged because the thrust on the corners is difficult to provide for, and it is impossible to equalize the unit pressures on the soil.

Where Footing Area and Load Are Eccentric

Where eccentricity of load axis and center of area is unavoidable, it becomes necessary to carry the stepping back, well up into the supported wall, in order to utilize the resistance of the wall in the distribution of the load and so reduce the effect of eccentric load on the bearing.

In any case of eccentric load it is required that the axis of the entire load shall fall within the middle third of the footing section. This is to gain stability; but even with this precaution, overturning moments will be present, due to irregular pressure on the soil; and as is usually the case where the load axis is outside the footing center, the increased pressure on the outside footing edge tends to increased settlement at that edge and the necessity of floor construction to resist tension and prevent spread of the walls becomes apparent.

Rules for Design of Footings

Four general rules may be set up for footing design:

(a) Combined unit loads must not exceed the allowable.
(b) Settlements must be equalized.
(c) Keep the axis of load concentric with the center of bearing.
(d) Economy of design, including excavation.

Material for Footings

As to the material for footings, these may vary from a trench filled with sand or gravel to reinforced concrete, depending on the qualities of strength, permanence and economy. It may be said, however, as the conditions to which footings are exposed are very severe, the best available material and workmanship are advisable. Then confidence may be established in this generally inaccessible part of the construction.

The introduction of structural steel in wall and pier footings has increased their strength and has extended equalized load distribution, as well as tending to economize in the weight of footings and the extent of the excavations. This use of steel is, however, frequently the cause of much waste of material and of useless expense. Throwing steel shapes into concrete with no intelligent understanding of the object to be gained is poor practice and is to be decried. This is a subject of technical design, and as such it should be given competent consideration.

Use of Reinforced Concrete Favored

The use of reinforced concrete, properly designed for footings, is increasing very largely; and where care is used to obtain dense concrete and protection against corrosion of the inaccessible reinforcement this would appear to be the most acceptable form of foundation material at this time.

The mat foundation, extended as a unit covering the entire area and supporting the entire building, is not today in as good repute as formerly. This type of foundation, which was the natural outgrowth of an increasing requirement for more bearing area, has passed through a considerable history of both theory and practice; but the actual difficulties and failings met in practice, combined with increased theoretical knowledge of the variation in soil resistance under unit loaded areas, tends today to favor deep foundations under conditions where allowable unit load distribution results in overlapping of resistance areas. Such deep foundations include the use of piling as well and piers carried down to more resistant soil strata.

Spread Footings Are Individual Problem

As in all foundation problems, the use of spread footings should be based on special study of the individual case. A complete understanding of the foundation requirements must depend on knowledge of the structural loads to be borne; and the structural design must again be adapted to the foundation conditions, so that the two are in satisfactory combination to produce the desired co-operation. Then, with the right design, good materials and closely supervised execution, it may be possible to forget the foundations after the building is completed.

Competent Inspection Insurance Against Failure

The specification and test of materials and the inspection of workmanship are today the very best forms of insurance against failure in engineering construction.

Given the assurance of quality in material and in workmanship, the engineer may apply his ability to the pure design with no premonitions of failure from fault in material or deficiency in workmanship.

Deep Foundations Defined

Collectively, deep foundations include all forms of piling and of piers resting on soil sub-strata below the elevation of ordinary excavation. While in the past various forms of piling and pier construction have been in use, today the field is pretty well covered by the use of concrete piles, or by some variation of those other and bigger concrete piles, commonly called caisson foundations.

Concrete piling, first conceived to overcome certain obvious faults of timber piling as permanent construction units, have increased in use as the timber pile has become more difficult to obtain. The two forms in use are the precast and the cast-in-place. Of the latter it may be said that, in addition to limitation as to length, there is an unknown factor in its use, more or less eliminated in direct ratio to the care used in workmanship and in supervision. This factor is of course the uniform density of the concrete placed in the form; and as there is no means of inspecting the pile after filling the forms the factor remains an unknown element.

The precast pile, on the contrary, is subject not only to close supervision of material and workmanship under construction, but is susceptible to detailed inspection and test when complete, and before driving.

The Cast-in-Place Types

The cast-in-place concrete pile may be of a type where the thin shell is driven, including a collapsible core, the latter being then withdrawn and the shell filled with concrete and remaining in the ground; or it may be the form where casing of sufficient strength is driven, dredged out and filled in short steps, the pile being pulled after each partial filling until the whole casing is removed and the concrete remains. This latter type includes the various systems of expanding the bases, called mushroom bases. But all of the cast-in-place types are subject to the unknown factor, and for this reason their use calls for every possible care in manipulation and supervision to insure the nearest approach to certainty of a 100 per cent pile.

Advantages and Limitations of Precast Piles

The precast pile, like any reinforced concrete work, is dependent on two factors only, before being driven—correct design and good concrete, both of which may be certainly established and the product accepted for use or rejected.

The design of the precast pile is of the most flexible character, and may be perfectly adapted to any established condition, including the necessary handling of long units in transportation and driving, which must also be considered in the technical design.

While the adaptability of the concrete pile to requirements in size, both of length and diameter, to conditions of driving and maintenance and the general availability of the materials make the use of these piles eminently reasonable, yet we must consider their use, as with all piles, as subject to limits. It is well established that under certain conditions the driving of piling tends to disturb the soil structure, and while in some ground every pile driven tends further to compact and increase the bearing value of the soil, in other ground the reverse may be true, and excessive piling may end in changing the entire character of the soil to a puddled mass with no bearing value.

Use of Piers and Caissons

For such conditions, and where the total loads are beyond reasonable unit distribution, we resort to the use of piers of masonry or concrete, erected in excavations and resting on some suitable sub-stratum of the soil or upon bed-rock.

In certain places where conditions have demanded deep foundations to carry high loads, the type of pier foundation using a caisson sunk to the bearing stratum and filled with concrete has been successfully adopted.

This system of building foundations is a development to suit conditions, an adaptation of methods used in bridge pier construction to a different requirement. Such pier construction has become known as caisson foundations; and in fact the piers themselves are commonly spoken of as caissons. This is not, however, correct because the caisson is the box or cofferdam used to prevent caving in of the soil during excavation.

Methods of Caisson Construction

True caisson construction comprehends the sinking of the caisson or box through the whole distance from the surface to the bearing sub-stratum by excavating below the bottom edge and adding sections to the top as the sinking progresses. The common building procedure as brought to a high degree of efficiency, in Chicago particularly, comprises the excavation and lagging of successive sections from the surface down, and is not properly caisson work at all.

The use of the pier construction commonly called caisson construction gives us the advantage of bearing soils of high unit value, and the means of concentrating the building loads. Where bed-rock is used as the bearing foundation, subsequent troubles should be at the zero mark. On other materials, even the best hard-pans, some settlement will take place and must be considered.

Where some of the piers of a building are based on bed-rock and others on hard-pan, unequal settlement is possible and must be given consideration in the building design.

The difficulties of caisson sinking are matters to be mastered by intelligence and experience, although in cases these difficulties may rise almost to a prohibitive degree. The value of the completed pier rests on competent design in proportion, and the qualification of the concrete or masonry used in construction.

Caisson Piers Must Have High Quality

There can hardly be over-emphasis placed on the necessity for 100 per cent materials and workmanship in these tall piers left buried and inaccessible in the ground, and on which we rest millions of dollars of building construction and the safety of thousands of human lives.

The pile not driven to bed-rock resists load through both friction between the pile surface and the soil, and the point resistance at the end. The caisson that is not based on bed-rock acts as a pile and resists the load force in the same way. The pier, then, is really a huge pile.

The pile driven to bed-rock is a slender pier, end resistance only being in evidence.

The oversize concrete pile cast in place, which we call a caisson pier, has this advantage over the ordinary concrete pile cast in place, that it is accessible both for investigation of the end bearing stratum and for uniformity and density of the concrete. Both of these are unknown factors in cast-in-place concrete piling.

Migrating underground waters bearing agents of decomposition threaten the mineral combinations in portland cement concrete. This phenomenon is attracting wide interest and investigation among concrete students. Wherever there is possibility of such water action, now or in the future, intense pre-study of the situation is necessary so that preventive measures may be taken and the integrity of the foundation secured.

Advance in Art of Concrete Engineering

Advance in the art of concrete engineering has made possible the design of concrete mixes for any desired unit strength within the limit of the material, and the specified standards of test and inspection of materials and workmanship have placed portland cement concrete in the list of quality materials of engineering. Today the engineer may design with a new confidence. With the assistance of competent tests and inspection his conception is based on known factors and the results will justify his ability.

Testing Society Sessions at Atlantic City

The 1932 meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., from June 20 to 24. Practically the entire group of sessions will take place at Haddon Hall.

A symposium on the significance of various tests in judging the quality of concrete is to be included in the program, according to an early announcement.

~ PERSONALS ~

W. M. Holm, who was for several years with the railways bureau of the Portland Cement Association, where he was engaged in the introduction of scientific methods of concrete-making in the construction departments of railways, and later was engineer for a ready-mixed concrete plant in Albuquerque, N. M., recently was engaged by the Yosemite Portland Cement Corp. as field engineer.

His headquarters are at the company office, 444 Market Street, San Francisco.

J. E. Jellick has been placed in charge as district engineer of the newly reopened San Francisco office of the Portland Cement Association at 564 Market Street.

Mr. Jellick has been active for several years in construction and promotional work throughout Pacific Coast territory. He was formerly in charge of the association office at Los Angeles and was later with the Calaveras Cement Co.

D. R. ("Spec") Collins has joined the Economy Concrete Products Co., Wauwatosa, Wis., as sales manager.

His activities are centered in the development of the Breeko cinder unit whose manufacture the firm has recently undertaken.

George Warren, assistant general manager of the Portland Cement Association, has been transferred to San Francisco, where he has general charge of the association's Pacific Coast activities.

T. B. (Ben) Warden has been named district engineer for the greater part of Texas by the Portland Cement Association. His offices are located in the Dallas Athletic Club building.

Residence of Clarence E. Day, architect, Lake Angelus, Michigan

Concrete Ashlar Masonry Opens New Architectural Field

Wisconsin Concrete Products Association Meeting Hears Illustrated Talk on New Product—Architectural Beauty at Moderate Cost—For Interior and Exterior Work

THE development of new products and the extension of uses for established products constituted the features most frequently emphasized in the papers and discussions presented during the annual meeting of the Wisconsin Concrete Products Association, at Milwaukee, Wis., on January 28 and 29.

Ashlar Construction Paper

A paper that was outstanding in point of thoroughness, and in its interest to more than a hundred delegates in attendance, was that presented by W. D. M. Allan, manager of the cement products bureau of the Portland Cement Association, on the subject of "Concrete Ashlar Construction." The paper was illustrated with a film made up of photographs, sketches and similar material which gave emphasis to the major points of the development, present use and future possibilities of this type of concrete masonry. To those who now are making variable-sized units for use in ashlar construction and those who are getting ready to develop a market for these products, Mr. Allan offered many helpful suggestions. He traced the history of ashlar masonry, showing that concrete ashlar is a modern form of an age-old type of masonry which can be used successfully and economically in all types of buildings.

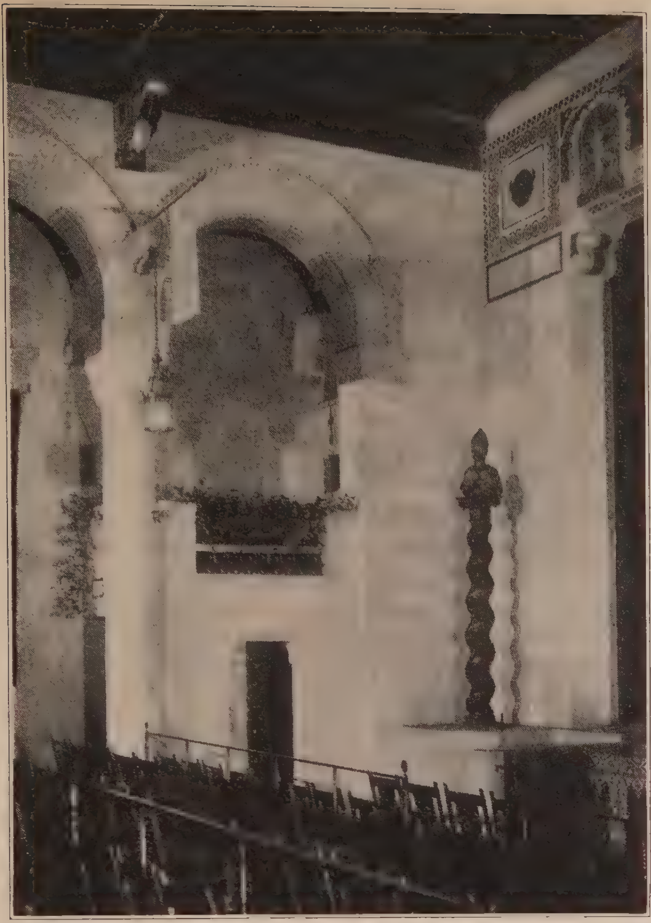
Of Interest to Architect and Manufacturer

It may be said without hesitation that concrete ashlar masonry is a subject of major interest to architects as well as to manufacturers of concrete masonry units. The architect, no less than the manufacturer, is interested in the effects obtained with the typical patterns, showing the value of using only a few sizes of units; in the manufacturing process, the construction details, the coloring, texturing and painting.

Random and Coursed Ashlar Defined

In random concrete ashlar several sizes of units are used in a pattern which looks like random masonry when it is repeated again and again in the wall. Of course, the units may be laid without a pattern, in which case it is true random ashlar; but best results are obtained when the mason has a pattern to follow. This speeds up laying, and the owner and architect get the exact wall effect they want.

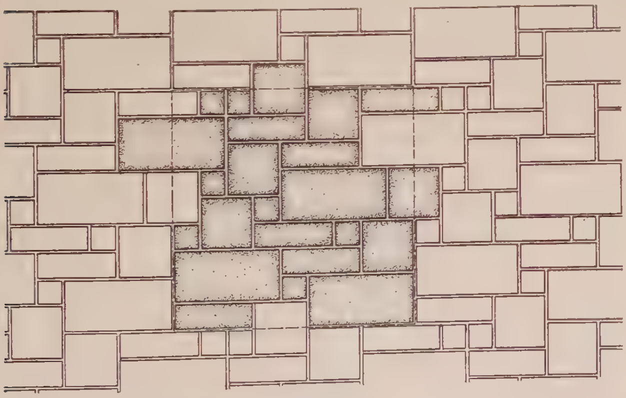
There are two types of coursed ashlar, that in which



Interior of Players' Theatre, Detroit. These walls are random concrete ashlar, finished with one coat of portland cement paint applied to the open-textured surface of the units

all horizontal joints are continuous and that in which the horizontal joints are continuous only at definite intervals.

Samples of concrete having open-textured surfaces, which can be produced in concrete masonry or in slabs for use in building walls that will have good sound absorbing properties, were inspected by the audience.



Random ashlar pattern, showing possibilities of pattern utilizing only four sizes of units

Beauty at Low Cost

Another feature about concrete ashlar masonry that is of outstanding interest to architects is that artistic architectural effects may be obtained at low cost. In this respect concrete ashlar masonry stands alone.

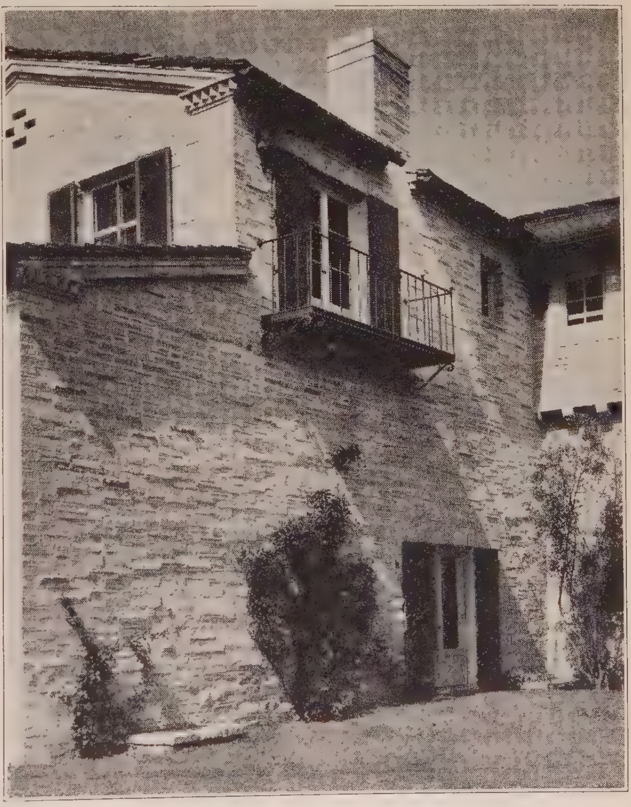
"No matter what type of ashlar is promoted in your community," said Mr. Allan, "there is an opportunity to advance the cause of concrete masonry by emphasizing the beauty which can be built into the wall at low cost."

Mr. Allan advocated the use of concrete ashlar for either exterior or interior walls, urging the manufacturers to experiment with this type of construction and to invite architects to contribute their ideas by designing experimental walls.

Such walls may be utilized to improve the appearance of a concrete products plant office or a downtown display room.

Other Important Developments in 1931

In 1931 many developments occurred within the concrete masonry industry which will justify greater confidence, on the part of the architect, in all forms of concrete masonry building units. Notable items among these developments were (1) that a comprehensive series of wall tests on the stability of concrete masonry was completed; (2) that the American Society for Testing Materials adopted a tentative standard specification for concrete masonry; (3) that the Federal Specification Board adopted a purchase specification for concrete masonry units; (4) that progress was made toward adopting A. S. T.M. and federal purchase specifications for concrete brick; (5) that the importance of shipping concrete building units in air-dry condition was recognized by many manufacturers; and (6) that concrete ashlar was developed and now is becoming generally accepted for exterior and interior walls.



Concrete ashlar masonry walls in residence of Robert B. Henderson, Hillsborough, Calif.

American Concrete Institute Hears March of Progress

Improved Design and Construction Methods to Be Described in Technical Papers—Concrete Masonry Association Holds Separate and Joint Sessions—Committee Reports to Be Advanced

THE twenty-eighth annual convention of the American Concrete Institute, which starts its sessions at the Wardman Park Hotel, Washington, D. C., on March 1, continuing through to March 4, has a program well filled with subjects of interest to men who deal with concrete and its products in any of its forms.

Reinforced Concrete Column Tests

The tests of full-sized reinforced concrete columns which have been in progress at the University of Illinois and at Lehigh University for more than a year will be discussed in a further report to be presented by F. E. Richart, chairman of Committee 105. Recently the fourth progress report on this investigation was published[1] in two sections.

The first section, by F. E. Richart and G. C. Staehle, reported that part of the work which has been conducted at the University of Illinois as having been completed, with the exception of a few long-time tests under sustained working loads which are still under observation. An important disclosure in this report is the fact that in one of the groups of test columns the stresses in the vertical steel, calculated from the measured strains, reached values as high as 26,700 lb. per sq. in. in a column made with 3,500-lb. concrete and with 1.5 per cent of vertical reinforcement. This column had been held under A. C. I. design loads for one year. In similar columns held under New York building code design loads the measured stress in the vertical steel reached a value of 30,800 lb. per sq. in. In both cases the yield point of the steel was 45,600 lb. per sq. in.

The second section of the fourth progress report, written by Inge Lyse and C. L. Kreidler, covered the part of the more recent tests conducted at Lehigh University. The Lehigh tests are reported as having been completed, the data worked up and diagrams drawn prior to the death of Prof. Willis A. Slater on October 5, 1931. The Lehigh tests had been conducted under his supervision. Lyse and Kreidler also report results of tests on columns held under sustained working loads for one year, after which the columns were tested to failure. An interesting result of these experiments was the disclosure that the average strength of columns subjected to working loads for one year was 1.6 per cent greater than the average strength of their companion columns which had not been previously loaded. From this the conclusion is drawn that the supporting of working loads does not affect the strength of columns.

Tests of Concrete From Transit Mixer

S. C. Hollister, professor of structural engineering, Purdue University, will report the results of his tests conducted at Columbus, Ohio, during the summer of 1931, on concrete mixed in transit mixers. The purpose of this investigation was to determine (1) the relation between the strength of the concrete and the time of mixing; (2) the relation between the time of mixing and the degree of uniformity in the concrete produced; (3) the effect of re-gauging, and various other observable features. An abstract of Prof. Hollister's paper is printed elsewhere in this issue of CONCRETE.

Deflections in Tall Buildings

Of special interest to structural designers is a paper to be presented by L. J. Mensch, civil engineer and contractor, Chicago, on "Deflections and Vibrations in High Buildings."

The first part of the paper contains an excellent presentation of the subject of deflections in tall buildings. The author presents a simple method, one in common use, for estimating the shear in the columns, due to wind pressure. He considers this method adequate for buildings up to 30 stories high, but he asserts that a simple proof that such is the case is lacking. He then proceeds to work out a simple proof by the moment area method, and shows how to consider the relative stiffness of columns and girders.

Structural Performance of Concrete Masonry Walls

The morning session of Wednesday, March 2, will be given over to various papers dealing with concrete masonry and other concrete products. In this session the Institute will be joined by the delegates to the annual meeting of the Concrete Masonry Association, to be held at the same hotel on March 1 and 2.

A paper of exceptional importance to architects and structural engineers, scheduled for this session, will be presented by Prof. F. E. Richart, University of Illinois, on the subject of "The Structural Performance of Concrete Masonry Walls."

In this paper the author discusses the results obtained from the wall stability tests conducted during the first half of 1931 at the University of Illinois,[2] in co-operation with the Concrete Masonry Association and the Portland Cement Association. The walls tested included 51 full story-height panels, 9 ft. 6 in. high and 6 ft. long, and 40 smaller "wallettes," 4 ft. high and 2 ft. 8 in. long. Different types and sizes of hollow concrete masonry building units, made with various aggregates, were employed in the construction of the test walls and "wallettes."

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[1] *Journal* of the American Concrete Institute, January, 1932.

[2] See CONCRETE, August, 1931, pages 15-16.

Conclusions Reached

Among the author's conclusions, the following are of special interest:

1. The compressive strength of large wall panels depends mainly upon the strength of the building units. The average ratio between strength of wall and strength of unit was found to be 0.53.
2. The factor of safety of walls in compression, based upon allowable building code working stresses of 70 and 80 lb. per sq. in., varied from 4.4 to 11.5.
3. Composite walls of face brick and hollow concrete building units developed high strengths and showed satisfactory interaction of the two materials.
4. Walls under eccentric compressive loads applied at the edge of the middle third of wall thickness deformed consistently, and developed strengths about three-fourths of the strengths of axially loaded walls.
5. The flexural strength of walls depends upon the adhesion of mortar to the unit, with failure following a horizontal mortar joint.

Strength of Walls After Fire Exposure

Among the other papers to be presented during the session on concrete masonry will be an interesting report on "Strength of Concrete Masonry Walls After Standard Fire Exposure," by C. A. Menzel, of the Portland Cement Association. This report contains a record of the strengths of wall panels after being subjected to fire tests conducted for several years at the laboratory of the association, in Chicago.

"The Effect of Mortar Strength on the Strength of Concrete Masonry Walls" is the subject of a paper to be presented by R. E. Copeland and A. G. Timms, of the Portland Cement Association.

Masonry Cements

J. C. Pearson, director of research, Lehigh Portland Cement Co., will present a paper on "Properties and Problems of Masonry Cements." Masonry cements are defined as those particularly adapted to use in mortar for laying brick, terra cotta, concrete masonry units, and natural and cast stone.

The author points out the value of qualities other than strength, such as plasticity, volume change, adhesion, and other properties, and he suggests the need for specifications that will place proper value on these properties. At the present time, he asserts, there are about 40 brands of masonry cements on the market that are neither natural nor puzzolan cements.

Specifications for Concrete Burial Vaults

W. D. M. Allan, manager of the cement products bureau of the Portland Cement Association, will present a proposed specification for concrete burial vaults, as a recommendation of Committee 709, of which he is chairman. The proposed specification has been prepared by committees representing the National Concrete Burial Vault Association, the Portland Cement Association, and the American Concrete Institute.

Cast Stone and Color

"Cast Stone as a Means to Color in Architecture," is the subject of a paper to be read by Fred R. Lear, of the department of architecture, Syracuse University.

Tentative Standards to Be Advanced

Many other papers and reports will be offered to the convention. Arthur R. Lord, consulting engineer, Chicago, who is chairman of Committees 502 and 506, will present motions to submit to letter ballot for adoption as standard, the present Tentative Construction Specification for Concrete Work on Ordinary Buildings (502-31-T), and Tentative Construction Specification for Concrete Work on the Small Job (506-31-T). A similar motion is to be made by William F. Zabriskie with the view of moving up the Tentative Specification for Supplying, Fabricating and Setting Reinforcing Steel on Ordinary Buildings (503-31-T) to the status of standard. Mr. Zabriskie is chairman of Committee 503.

Many Valuable Technical Papers

A number of technical papers dealing with various phases of construction projects and laboratory investigations are scheduled in addition to those already discussed. Among these are "Problems in the Design and Construction of Concrete in Major Irrigation Structures," by Byram W. Steele, civil engineer, U. S. Bureau of Reclamation, Denver, Colo.; "Concreting Problems in the Chats Falls Power Development," by Col. H. L. Trotter, Fitzroy Harbor, Ont., and Wilfred Schnaar, Hydro-Electric Power Commission, Toronto, Ont.; "Special Finish Concrete Sidewalks," by David Lynn, architect of the Capitol, Washington, D. C.; "The Design of Concrete Arches in Allegheny County," by G. S. Richardson, Department of Public Works, Allegheny County; "The Construction of Concrete Arches in Allegheny County," by V. R. Covell, chief engineer, Bureau of Bridges of Allegheny County, Pittsburgh, Pa.; "Design, Construction and Test of the Rogue River Bridge," by Albin L. Gemeny, U. S. Bureau of Public Roads, and C. B. McCullough, bridge engineer, Oregon State Highway Department; "Studies of the Workability of Concrete," by T. C. Powers, Portland Cement Association, Chicago; "Relations of Cement Content, Strength, Water-Cement Ratio, and Durability," to be presented as a report of Committee 114 by L. W. Walter, chairman; "Design and Construction of the Mt. Vernon Memorial Highway," by R. E. Toms and J. W. Johnston, U. S. Bureau of Public Roads; "Proposed Specification for Concrete Pavements for Municipalities," to be offered as a report of Committee 902 by F. C. Lang, chairman; and "The Mortar Voids Method of Designing Concrete Mixtures," by Mark Morris, Iowa State Highway Department.

Hollister to Be New President

It is expected that S. C. Hollister, professor of structural engineering, Purdue University, will be elected president for the coming year, succeeding Duff A. Abrams.

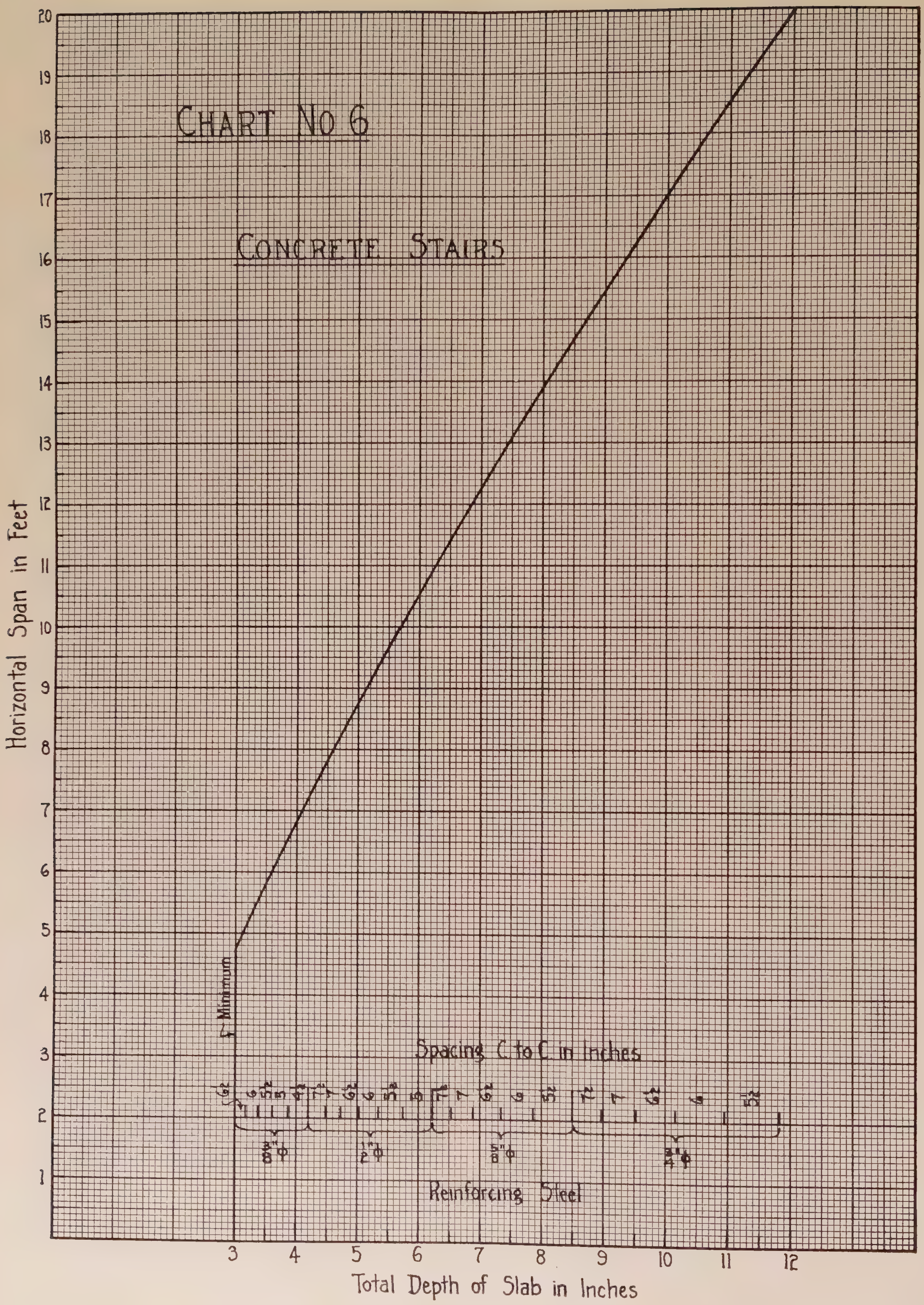


CHART No 6

CONCRETE STAIRS

Cutting Corners in Concrete Structural Design

Slab Thickness, Steel Reinforcement and Distribution of Loading in Two-Way Slabs

V—Concrete Stairs and Load Distribution in Two-Way Slabs

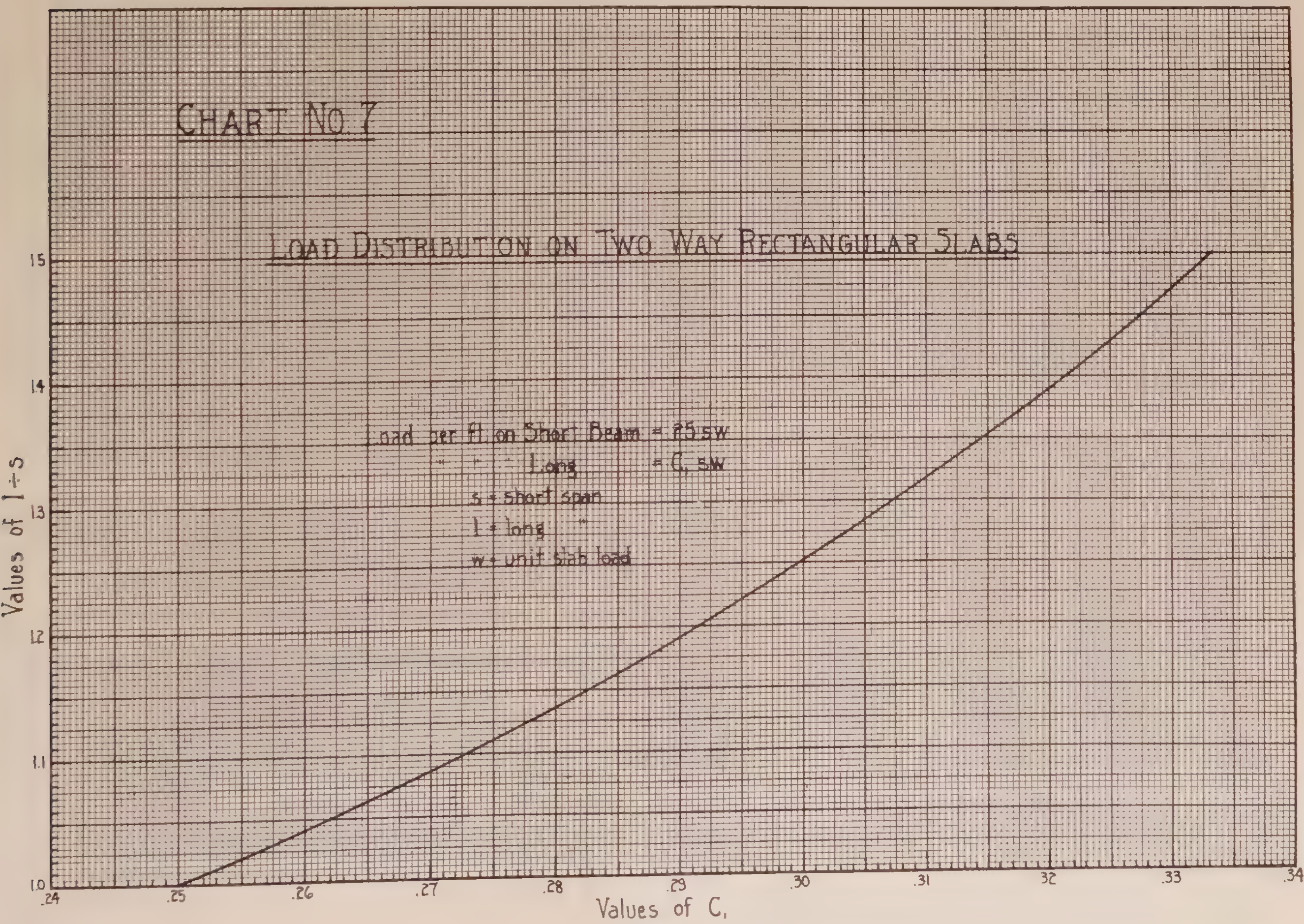
By J. R. GOETZ*
Structural Engineer, Chicago, Ill.

ENGINEERS are often asked by architects, particularly in preliminary designs, for the thickness of slabs supporting stairs. In a vast majority of cases the design conditions are uniform,—that is, the stairs are to have 1 in. of cement finish on the treads and risers, they are to have a plastered soffit, and must be capable of supporting a live load of 100 lb. per sq. ft. Also, most codes allow a fibre stress of 20,000 lb. per sq. in. in the steel, 800 lb. per sq. in. in the concrete, and require a minimum of ¾-in. clear fireproofing below the reinforcement. Chart No. 6 is based upon these requirements, and gives the total thickness of slab and the size and spacing of steel for simple spans up to 20 ft., at a glance.

Load Distribution in Two-Way Slab

Several methods have been advanced for the calculation of the distribution of the slab load to the marginal beams in a rectangular two-way slab. A simple method, and one which the writer understands will be used in the new Chicago building code, is that illustrated in Figure 1.

The load to be transmitted to the short beam is that due to an area bounded by the triangle a-b-c, while that going into the long beam comes from the trapezoid a-c-d-e. These loads are considered as being uniformly distributed along the beams. The limit of the ratio of the long to the short side should be 1½ to 1. Chart No. 7 gives an easy solution to the above conditions, as soon as the ratio of lengths of the sides has been found. Multiply the unit



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*Formerly chief engineer for Ben Marshall, architect, Chicago, Ill.

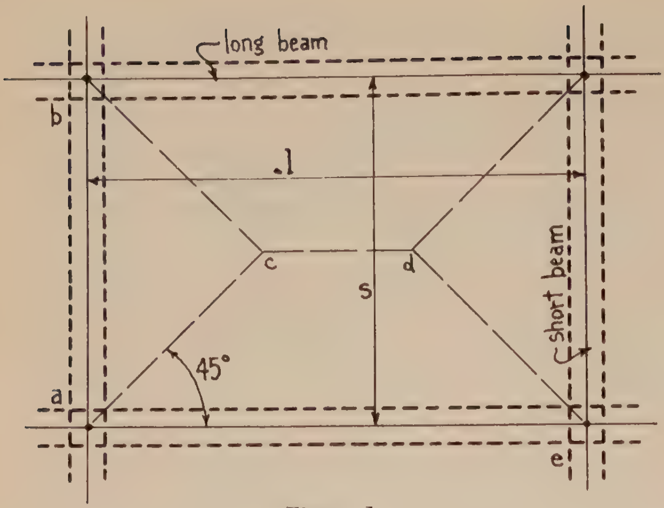


Figure 1

slab load by the length of the short side. This product, when again multiplied by either 0.25 or the coefficient C, as given by the chart, gives the loading per ft. on the short and long beams, respectively.

Thinks Machine Age Efficiency Is Out of Control

Austin Crabbs Stresses Need for Proper Balance Between Efficiency and Purchasing Power

In the following letter from Austin Crabbs, manager of The Cement Products Co., of Davenport, Iowa, he discusses the editorial "Tomorrow—1932," printed on the front cover of the December issue of CONCRETE.

While Mr. Crabbs has taken exception to a part of that brief editorial, he would find that, if our ideas concerning "the way out" were set forth in greater detail and in more comprehensive scope, we would not be so far apart. Certain it is that when one industry, through a great increase in labor-saving machinery, reduces its employes by half, the slack must be taken up in other directions if distress is to be avoided.

In the meantime we continue to believe that "economy, alertness and up-to-date knowledge" will be necessary so far as the individual firm is concerned.

Mr. Crabbs is a leader in the concrete products industry and an able thinker. The ideas he expresses here may encourage other readers to set their opinions down on paper and let us have them for publication. A round-table discussion in the pages of CONCRETE will be of benefit to all. Mr. Crabbs' letter follows:

Editor of CONCRETE:

Ever since receiving the December issue of CONCRETE, I have been studying the editorial on the cover of this particular issue and the more I think about it, the more I believe that this is the wrong doctrine to preach at this time and that the industry should begin to think along somewhat different lines. I realize that a person should not criticize any program, without having a substitute to offer; but our present problems are so complicated, that it will take the best efforts and careful thought by everyone interested in this proposition, to find the correct solution.

The editorial to which I refer, consists of six paragraphs. I agree with the first paragraph, that it is time to pause and consider what is to be done for the coming year. I also agree with the second paragraph, that constructive planning is possible and very much worth while. Also in the third paragraph you are correct in stating that new ideas have been developed and new ways for doing things have been found of necessity, and that the lash of competition has caused the manufacturers to bring out new products.

As to the last three paragraphs of this editorial, I notice the use of the phrases "simpler methods, cheaper handling, speedier results, new materials, better equipment, new things to make, reduced overhead, simplified operations, lower production costs, economy, alertness, and up-to-date knowledge, to which we are pledged to devote our most earnest efforts." These phrases are based on the hope, for the individual who follows these doctrines, that in some way or other he will be able to reduce his own costs in such a way as to make a profit for himself against the keenest competition.

I find a growing feeling that this sort of propaganda, in this country at least, has been carried to an extreme and may be partly responsible for present conditions. Increases in efficiency often result in the closing of competitors' plants and have decreased the number of wage earners employed and in this way decreased the combined purchasing power of the population.

It is high time that all persons interested in manufacturing of any kind whatever, at least pause to consider the path that we are at present traveling. It seems to me highly probable that some way must be found to balance minimum selling prices to the ultimate consumer as obtained by increased efficiency, against some means of giving jobs to our unemployed, even though this in some cases may mean higher final selling prices.

The future may even disclose that one means of obtaining such a balance will be shorter working hours and more men employed in a given industry. I am frank to admit that I do not know what the solution is, but I do feel that any discussion of the future, which does not take into consideration just what this highly organized, super-efficiency is leading us to, is likely to do more harm than good. This side of the question can not be overlooked, if a remedy is to be found.

Many people are beginning to wonder if our machine age has not gotten out of control. If this is so, it is time to soft-pedal "efficiency" until such time as we are able to find ways and means of adapting it to the ultimate well-being of the multitude. Let us not overlook the fact that machine age efficiency can be carried too far without a corresponding increase in the purchasing power of the people.

AUSTIN CRABBS,
Manager, The Cement Products Co.

Davenport, Iowa,
December 31, 1931.

Highway Engineer to Address Reinforcing Manufacturers

The eighth annual meeting of the Concrete Reinforcing Steel Institute will be held at the Atlanta Biltmore, Atlanta, Georgia, on March 7 to 9.

The second day's session is to open with an address by Searcy B. Slack, bridge engineer for the Georgia State Highway Board. Concrete highway bridges will be the subject of his talk.

HOW TO DO IT

✦ Questions and Answers ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

To Produce a Glossy Finish on Concrete

We have made experiments with a commercial preparation to produce a glossy finish on cast concrete units and ornamental concrete tile for exterior and interior trim. Results seemed very promising at first, but the glossy surface produced could not withstand weathering.

Can you tell me of any recent developments toward attaining a glossy finish without mechanical polishing?—E. C. F., Milwaukee, Wis.

A recent issue of *Concrete Building and Concrete Products*, published in London, England, mentions a German patent (No. 57,540) covering a process which is said to produce a good glaze on hardened concrete by the use of a magnesium chloride solution.

We have no means of verifying the claims of the patentee, but the procedure is given below as described in the British publication mentioned. According to the procedure given, gelatine is dissolved in a magnesium chloride solution of 1 to 3 per cent, and then, while mixing thoroughly, one part of each of the following is added: water glass, oil, gypsum, prepared chalk, magnesium oxide, magnesium carbonate, calcium oxide, calcium carbonate, aluminum oxide, iron oxide. The composition of the material is said to give to the surface of the concrete a smooth, shiny and transparent glaze, which closely resembles natural stone polish, and the magnesium chloride solution causes especially a good hardening of the glaze.

Experiments and time alone will determine whether the process has lasting merit.

Resurfacing Old Concrete Floor in Business Building

The article on resurfacing old roads and streets with concrete slabs, printed in the January issue of CONCRETE, *suggests a problem we have here. Can a 2¼-in. new concrete slab be put down on an old concrete floor in a business building? Would you bond the two floors together in some way, or just run the new floor on to the old floor?—J. M. T., Willow, Okla.*

You should have no trouble in placing such a resurfacing slab successfully. The old floor should be thoroughly cleaned with soap and water, then rinsed off with clear water. Or, if there are oil stains on the old floor, it should be washed with a caustic soda solution as described on this page in the January (1932) issue, and then thoroughly washed with clear water to remove any remaining traces of caustic soda.

When the new slab is placed, a cement-and-water mixture or grout of about the consistency of thick paint should be brushed on the old floor, just ahead of the new concrete.

This method of cleaning the old floor and placing the new concrete will provide ample bond between the old work and the new.

Concrete Engineering Terms in Spanish Language

Can you refer me to an authoritative publication containing concrete engineering terms in the English and Spanish languages?—I. A. C., Ithaca, N. Y.

The Pan American Division of the American Road Builders' Association has compiled a list of more than 2,000 words and phrases, under the heading "Highway Nomenclature—English-Spanish," which is now available in mimeographed form.

While this compilation is concerned primarily with words and phrases employed in highway engineering and construction, the list quite naturally includes a wide scope of terms used in other forms of engineering and construction work.

Inquiries concerning copies of this mimeograph should be addressed to American Road Builders' Association, Pan American Division, National Press Building, Washington, D. C.

Testing Dryness of Concrete Floors

I have some literature on placing linoleum directly on concrete floors, in which I find the statement that the concrete must be thoroughly dry before material such as linoleum, cork or rubber tile is cemented down. Can you tell me of some simple test that will show when the concrete is dry enough?—A. R. S., Bloomington, Ill.

The concrete floor must be clean, "bone-dry" and free from foreign material. A simple test for moisture in concrete may be made by placing pieces of linoleum face down on the floor—one at each corner of the room and another near the center, weighting the edges. After about 24 hours remove the weights and linoleum. If the concrete is not entirely dry, the face of the linoleum and the floor itself will appear slightly damp.

Curing Products Under Water

Would it be practicable to cure molded concrete products or cast stone by submerging the units in a vessel of water when taking them off the molding bench?—J. A. H., Montgomery, Ala.

Curing under water is one of the most effective methods. It is necessary, of course, to allow the concrete sufficient time to set before the product is placed in water, to prevent damage to the surface texture. The time required may be anywhere from a few hours up to 12 hours or more. Only an experiment will establish the exact time required for this hardening period.

New Books and Pamphlets

Concrete Ashlar Masonry

Concrete Ashlar Walls is the title of a new booklet issued by the Portland Cement Association. This 16-page booklet, 8½ by 11 in. in size, describes and illustrates a recently developed type of concrete masonry construction, the chief claims of which are that it is economical to build or decorate and that it possesses excellent acoustical qualities.

Residences, schools and other recently constructed buildings in which concrete ashlar has been used for both interior and exterior walls are illustrated in the booklet. There is a discussion of color treatments and textures that are possible with concrete ashlar, and a page showing interesting patterns which are suggested for coursed or random ashlar.

A copy may be obtained without charge by requesting it from the Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois. Distribution is limited to the United States and Canada.

Physical Properties of Cast Stone

The Physical Properties of Cast Stone is the title of Research Paper No. 389, issued by the U. S. Bureau of Standards as a reprint from the Bureau of Standards *Journal of Research*, December, 1931.

This is a 16-page paper-covered bulletin, 6 by 9 in. in size, prepared by John Tucker, Jr., G. W. Walker and J. Arthur Swenson as a report of part of the investigations undertaken to obtain data from which a purchase specification could be prepared for the consideration of the Federal Specifications Board. The tests conducted during this investigation included tests of strength, absorption and porosity, and the effects of freezing and thawing.

Copies of Research Paper No. 389 may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Crazing of Cast Stone

Crazing on Concrete Building Stone. By J. E. Buchanan. Published as Bulletin No. 2 of the University of Idaho, Moscow, Idaho. Paper cover, 24 pages, 6 by 9 in. Illustrated.

This bulletin comprises a report on the study of crazing of the concrete building stone employed in the construction of Science Hall, University of Idaho, built in 1924. In the effort to arrest further deterioration, two types of waterproofing were applied to the stone and results observed over a period of one year.

The bulletin contains a bibliography of published reports on the subject of crazing.

Estimation of Free Lime

The Estimation of Free Calcium Oxide and Hydroxide. By B. Bakewell and G. E. Bessey. Published by the British Department of Scientific and Industrial Research, as Special Report No. 17, 1931. Paper cover, 21 pages, 6 by 9 in.; one illustration. Price 6d.

This bulletin contains a general review of various methods for determining free lime in both hydrated and unhydrated materials. Several familiar American methods are described. Copies may be obtained by addressing His Majesty's Stationery Office, London, England.

ORGANIZATIONS

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 641 New Center Building, Detroit, Mich.
Twenty-eighth annual convention, March 1-4, Wardman Park Hotel, Washington, D. C.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.
Thirty-fifth annual meeting, June 20-24, Haddon Hall, Atlantic City, N. J.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.
Annual meeting, March 1-2, Wardman Park Hotel, Washington, D. C.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 1735 14th Street, N. W., Washington, D. C.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Building, Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wire Reinforcement Institute; R. D. Bradbury, Director, National Press Bldg., Washington, D. C.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

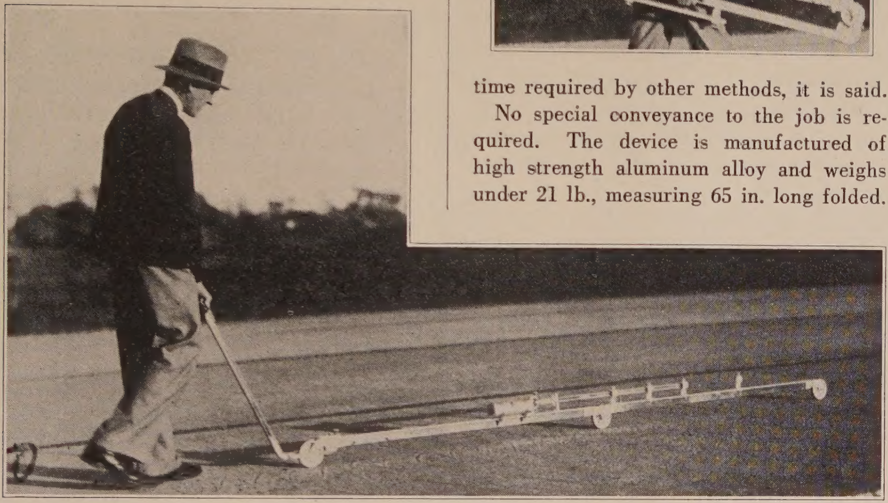
New Equipment and Materials

The Rid Indicates Pavement Errors with Buzz

The Rid is an electrically operated pavement surface detector designed to buzz whenever an area is found to be in excess of the provisions of the specifications and to sound until the area is passed. Low as well as high spots are indicated.

The Rid is accurate, measuring one thirty-second of an inch as readily as one inch, according to the Cambridge Corp., Homewood, Ill. It may be operated forward or backward with equal facility and can check the job in 30 per cent of the time required by other methods, it is said.

No special conveyance to the job is required. The device is manufactured of high strength aluminum alloy and weighs under 21 lb., measuring 65 in. long folded.

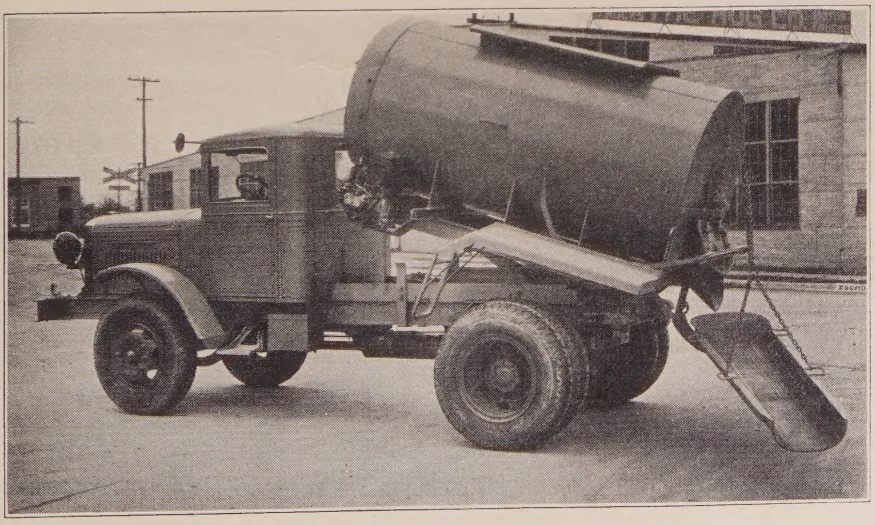


Hug Spring Blade Agitator for Ready-Mixing

The Hug spring blade agitator for transporting centrally mixed concrete is designed to keep the mass of wet concrete in a state of constant agitation during the entire trip and during unloading, without any throwing, dropping, lifting or tumbling action.

Use of this principle makes possible a haul of 150 miles or more from the plant to the job, of a uniform, full strength concrete, without segregation and without loss of water content by aeration, according to the Hug Co., Highland, Ill.

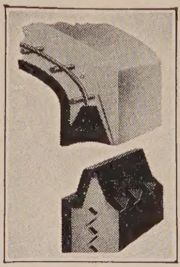
The action forces the spring blades down through the mass of concrete, displacing it from the bottom and side walls and causing a kneading action. The blades constantly rotate through the mass while in transit and while unloading.



Inner Asphalt Vault Is Feature of American Co. Product

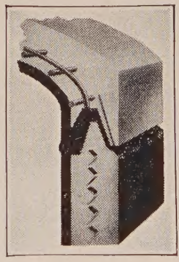
Patents have been secured for the Wilbert asphalt waterproof vault by Wilbert W. Haase, president of the American Vault Works, Inc., Forest Park, Ill.

One of the exclusive features of this vault, according to Mr. Haase, is the combination of an inner vault of asphalt and an outer vault of concrete, the asphalt being airtight and its insulating qualities insuring a constant, dry, warm temperature. Elimination of condensation or sweating and everlasting strength are said to be assured.



The inner asphalt vault is cast by pouring asphalt (heated to 410 deg.) into the inner vault forms.

The wall forms are removed the following day and the asphalt is chemically treated to soften its surface to a viscosity of hot asphalt for a depth of approximately three thirty-seconds of an inch. The outer forms are then placed and set around the inner asphalt vault. Steel reinforcing is inserted and adjusted and the concrete placed. The viscous surface of the asphalt is combined by diffusion with the unhardened concrete and bonding takes place, to a point where separation of the two materials is impossible, it is said.



The molded asphalt in the channel of the Wilbert cover is covered over with a plastic asphalt, filling the channel completely so that as quickly as the lower part of the cover comes in contact with the top of the sealing lip, the vault becomes airtight and a compression of air takes place by the settling of the cover to the outer resting ledges on the vault proper.

The ledges are a separate patented feature used exclusively in Wilbert Asphalt and American Monarch vaults, to eliminate the possibility of an imperfect seal caused by small stones and pebbles resting on the otherwise flat surface of the burial vault top when lowered in the grave.

Negotiations and plans are now being planned by the American Vault Works for a national expansion program on a royalty basis of licensing.

Manufacturing and sales rights will be awarded to manufacturers in exclusive territories.

About Manufacturers of Equipment

Industrial Literature

Cork Products Catalog

Jointite Cork Products is the name of a new catalog published by *Mundet Cork Corp.*, 450 7th Avenue, New York City. As stated by the manufacturers, it is "A compendium of information on the uses of cork for insulation purposes including useful data, specifications, tables, and charts for refrigeration, sound-proofing, heat prevention, heat conservation, vibration deadening, and condensation prevention."

Ciment Fondu Leaflet

Ciment Fondu, "the original high-alumina cement," is described in a 4-page folder issued by the *International Non-Staining Cement Co., Inc.,* Brooklyn, N. Y. This firm is the exclusive distributor for the United States.

Ciment Fondu is a special cement, having quick-hardening, high early strength property.

Barnsdall Admix Bulletins

The Barnsdall Tripoli Co., St. Louis, Mo., has published new 16-page pictorial bulletins, *Nos. F* and *G,* descriptive of the use of *Barnsdall Admix* as a workability agent and integral waterproofing for concrete, mortar, stucco and concrete products.

These bulletins will be sent to those interested.

Chain Belt Book

A 112-page book on its new line of Rex Roller chains has just been produced by the *Chain Belt Co.,* Milwaukee, Wis.

This publication, of a high caliber, comprises a catalog and engineering data book.

Adjustable Joist System

An 8-page folder issued by the *Adjustable Joist Corp.,* Milwaukee, Wis., describes the *Adjustable Joist System* of supporting concrete form work.

The distinct advantage of the system is said to be its elimination of upright wood shoring. Adjustable Joist are adaptable to any span, being adjustable in length from 7 ft. 6 in. to 28 ft. with 2-in. variations, and to any type of construction. Construction details and installations are shown.

Concrete Joist Floors

A picture story of speed with concrete joist construction floors is presented in the most recent 4-page folder to be issued by the *Concrete Reinforcing Steel Institute,* Chicago, Ill.

Photographic reproductions of structures located in various cities are accompanied by references to the speed with which they are completed.

Rex Road-Maker

The *Rex Road-Maker,* a paver said to be designed to meet 1932 job conditions, was announced during February by the *Chain Belt Co.,* Milwaukee, Wis. *Catalog 209,* just issued, describes the unit.

The features pointed out are, in part, its satisfactory operation in tandem hookups, faster charging and discharging, drum resistance to wear, and intensified positive mixing action.

Manufacturers' News

Beaumont Bin Co. Organized

The bin division of the *Beaumont Manufacturing Co.,* Philadelphia, has recently been reorganized as the *Beaumont Bin Co.*

The latter will devote itself entirely to specializing in the design and manufacture of all types of bins including storage and aggregate bins, central mixing plants, bulk cement handling, automatic weight batchers, and all types of bin gates.

A new bulletin showing the equipment offered is ready for distribution.

Medusa Buys Rust-Oy Output

E. M. Williams, president of the *Studebaker Chemical Co.,* Elyria, Ohio, announced on January 26 that the company's entire output of rustproof coatings sold under the trade name of *Rust-Oy,* and kindred protective coatings, had been sold to the *Medusa Portland Cement Co.,* Cleveland, Ohio, for national distribution.

St. Louis Plant Management

Joseph T. Ryerson & Son, Inc., have announced that the management of their St. Louis plant has been taken over by *Harold B. Ressler,* vice-president at Chicago. Mr. Ressler, who was formerly the St. Louis plant manager for fifteen years, will be in direct contact with the St. Louis organization, making regular visits to the plant and St. Louis territory.

In Mr. Ressler's absence, *R. B. Wilson,* manager of sales of the Ryerson St. Louis plant, will be the senior resident executive. Mr. Wilson, formerly of the Chicago service department, has been associated with the St. Louis organization for over seventeen years and is well known throughout the steel industry for his ability in solving steel and allied problems.

Barber-Greene Representative

The Barber-Greene Co., Aurora, Ill., announces the appointment of the *Boehck Equipment Co.,* Milwaukee, as its Wisconsin representative.

The Boehck Equipment Co. is a new organization with offices and warehouse at 2404 W. Clybourn Street. Members of the firm are experienced in the selling and servicing of conveyors, ditchers, and loaders, and the planning of yards and plants.

Branch Offices Combined

The Detroit branch offices of the *Besser Manufacturing Co.* and *Consolidated Concrete Machinery Corp.* have been combined at 5191 Loraine Avenue, Detroit, Mich.

A stock of parts for machines manufactured by both companies is carried at this address.

This office is under the management of *Fred M. Leach* and *James Rhodes.*

Sullivan Engineering Service

The Sullivan Co., Memphis, Tenn., manufacturers of waterproofing products, announce a new engineering service available to their trade. An engineering department is now maintained at the general office at Memphis, for the purpose of writing specifications to cover individual jobs.

Kelley Besser Distributor

E. B. Kelley, Inc., Frankford, Philadelphia, Pa., has been appointed the exclusive eastern distributor for *Besser Manufacturing Co.*